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The Study and Analysis Center at the TRADOC Analysis Center requested that the TRAC-LEE Vector-in-Commander (VIC) team conduct an analysis of the CSS portrayed in a Southwest Asia Corps/Division Scenario 7.0 (SWA CDS 7.0) excursion. The combat unit elements, combat service elements, and the combat service support elements needed to be analyzed individually to determine whether or not each of these sections would be able to effectively perform under the given scenario conditions. TRAC-Lee was tasked to analyze the CSS capabilities of the Army of Excellence (AOE) Heavy Division Design for (SWA CDS 7.0). The AOE heavy division design was dynamically gamed using the VIC model in the SWA CDS 7.0 scenario. The CSS elements represented in VIC were analyzed by TRAC-Lee with the primary focus of the analysis was on the maintenance and supply operations and how the CSS units functioned for the given scenario.

This analysis concluded that the CSS structure in the AOE Heavy Division Design can support the division during a 30-hour battle such as the one portrayed in the Southeast Asia 7.0 scenario. No CSS support services hindered the availability of any weapon systems. There were minor delays with respect to recovery vehicles and repair teams, but these delays were too inconsequential to consider them shortfalls in the CSS system.

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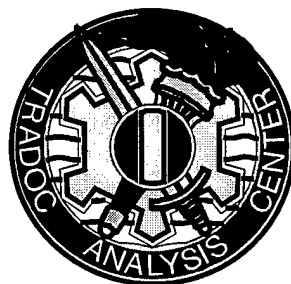
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# Combat Service Support (CSS) Vector-in-Commander (VIC) Analysis in Support of Southwest Asia Corps/Division Scenario 7.0 (SWA CDS 7.0) Excursion



## Army of Excellence (AOE) Heavy Division Design Technical Report



TRADOC Analysis Center - Fort Lee  
Peter Barnes                      John Steffey

June 12, 1998

Combat Service Support (CSS) Vector-in-Commander (VIC)  
Analysis in Support of Southwest Asia Corps/Division  
Scenario 7.0 (SWA CDS 7.0) Excursion.

CSS Analysis of VIC Dynamic Gaming Army of Excellence  
(AOE) Heavy Division Design.

Technical Report



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Combat Service Support (CSS) Vector-in-Commander (VIC)  
Analysis in Support of Southeast Asia Corps/Division Scenario 7.0  
(SWA CDS 7.0) Excursion

Army of Excellence (AOE) Heavy Division Design  
(SWA CDS 7.0) Excursion  
28May98 VIC Analysis Data

**1. General.**

a. Major Charles Davis and Captain Philip Buford of the Training and Doctrine Command (TRADOC) Analysis Center at Fort Leavenworth Study and Analysis Center (TRAC-FLVN SAC) requested that the TRAC-LEE VIC team conduct an analysis of the CSS portrayed in an SWA CDS 7.0 excursion. TRAC-LEE used VIC analysis to provide a quantitative indication of the effectiveness of the CSS during that endeavor.

b. The dynamic gaming with the VIC model is based on an excursion of the SWA CDS 7.0 scenario with a total duration of 30 hours incremented in four-hour time periods (TP) and one-hour reorder cycle time between CSS units. The modeled force consists of three armor brigades with corps support, one Marine Expeditionary Force (MEF) landing brigade, one regimental landing team, and allied (Kuwaiti and Saudi) forces. Specific descriptions and details for both the scenario and modeled force are provided in the main scenario report.

c. The analysis focuses first on those key maneuver unit resources necessary for a unit to perform its designated mission. The specific resources addressed are weapon system availability and the timely availability of supplies. Secondly, various aspects of the CSS system are examined to isolate bottlenecks or shortages, which limit the provision of needed services. And conversely, excesses or under-utilized CSS resources are identified for this scenario.

d. The analysis entails three major areas: maintenance, medical, and supply support.

e. VIC unit name designators are used in this report for brevity. Appendix A shows the cross-reference between actual unit names and VIC unit names.

**2. Model Description.**

a. The VIC model is a two-sided, deterministic simulation of integrated land and air combat. The level of resolution is the maneuver battalion. As a deterministic model, VIC is driven by expected values; weapon systems, transporters, inventories/stockage levels, and utilization can be fractional values. VIC is event-stepped for maneuver elements and both time-stepped and event-stepped for calculation of CSS effects. The combat and combat support (C, CS) functions in VIC produce a workload for the CSS system. Two key modules within VIC are used to represent the CSS system: Return to Duty (RD - maintenance and medical) and Logistics (LO - supply).

b. The RD module operates on equipment and noncrew personnel, both of which are referred to as systems, as well as crews for key combat vehicles.



(1) Workloads. The attrition modules generate combat damage and casualty workloads in the form of combat-damaged systems. These quantities are adjusted to factor out catastrophic damage/killed in action (KIA) and abandonments (equipment only) before becoming a workload on the maintenance and medical system. Reliability failures to equipment and disease and non-battle injury (DNBI) to personnel are also generated, resulting in their removal from units and their introduction as workload upon the RD system.

(2) Processes. The RD module contains representations of the recovery, evacuation, and repair functions for weapon systems and recovery, evacuation, and treatment of personnel.

(a) Recovery is constrained by the availability of operational recovery vehicles. Recovery operations are represented as a delay time, which includes round trip travel, hook-up, and drop-off. The recovery time varies from vehicle to vehicle and the primary location of that vehicle.

(b) Evacuation is constrained by the availability of operational evacuation vehicles and dynamic evacuation times that are a function of distance and time on the main supply route (MSR) network.

(c) Repair is constrained by the available strength and type of assigned mechanics or medical personnel. Repair throughput is impacted by the 'time to repair.' A maintenance unit's maintenance man-hours (MMH) are degraded by 50 percent when that unit has to relocate on the battlefield.

(3) Products. The final product of the RD module is the return of crewed systems to owning units. Intermediate products of the various RD processes include recovered systems, evacuated systems, and repaired systems.

(4) Combat impacts on RD processes. Impacts include attrition of RD assets, productivity degradation due to unit movement, changes in evacuation distances due to unit movements, and changes in evacuation speeds due to congestion of MSR links.

c. The LO module provides the support structure to facilitate the resupply of ammunition and fuel to maneuver units and the restocking of these supplies at supply units.

(1) Workloads. The attrition modules dynamically generate the workload for ammunition as units engage in conflict. As units move and change posture they create a workload for fuel. A workload for other supplies is generated by a daily utilization rate, depending upon unit types. When maneuver units deplete their basic loads to specified reorder levels, a utilization of resupply is levied on the CSS system.

(2) Processes. The LO module contains representation of the resupply and move functions. Resupply to maneuver units is constrained by the availability of resupply vehicles, availability of supplies at supply units, load times, and travel time between the unit and its supplier. The availability of supplies at supply points is constrained by transportation, availability of load facilities, and load/unload

times. The move function is constrained by the availability of CSS trucks, congestion of the MSRs, and travel times between supply units.

(3) Products. The final product for the resupply and distribution system is the replenishment of expended ammunition, fuel, and other supplies to maneuver units. Intermediate products include the restocking of resupply units and the movements of supplies along the MSRs from higher echelon supply units.

(4) Combat impacts on LO process. Attrition and movement of supply units as a result of combat effects degrade the ability of these units to perform their resupply function. Resources which can be destroyed at the supply units include resupply vehicles, stocks, and materiel-handling equipment (MHE). The relocation of supply units results in degradation of their receipt/issue capability during the move. In addition, attrition of resupply vehicles, both at the maneuver unit and along the MSRs, degrades the ability of the CSS system to deliver supplies.

### **3. Assumptions.**

a. When damaged weapon systems reach a maintenance facility, the correct tools, parts, and equipment are present at the facility. If the number of mechanics necessary to work on the damaged weapon system is available, they will begin working on the damaged weapon system immediately (i.e., prep time and time spent for damage assessment are not played in the model).

b. Resupply of all stockage items is available from echelons above corps (EAC).

c. All injured personnel will be recovered to the treatment facilities without constraint of availability of medical recovery vehicles.

d. The AH64D, OH58D, and AH-1 do not require assisted recovery. If one of these helicopters receives non-catastrophic damage, that helicopter is assumed to self-recover. Recovery assets will never impede helicopter RTC.

### **4. Sufficiency Criteria.**

a. Equipment. Maintain 80 percent availability of systems that have not been destroyed or abandoned. Rationale: Army Regulation (AR) 220-1, Unit Readiness Reporting, defines an equipment availability status of 80-90 percent as category C2 which is fully combat ready with minor risk.

b. Personnel.

(1) Have no weapon systems in awaiting-reissue queue due to nonavailability of crews. Rationale: The availability of weapon systems crews affects the availability criterion for combat systems.

(2) Maintain 80 percent personnel strength level for all modeled personnel. Rationale: AR 200-1 defines a personnel strength level of 80-90 percent as category C2 that is combat ready with minor risk.

c. Supply. Have no zero balance of any supply-class subitem (e.g., 155mm; 120mm; Petroleum (Bulk)). Rationale: The lack of a specific type could adversely affect tactical options.

## 5. Maintenance Analysis.

a. The six weapon system categories covered in this analysis are shown in Table M-1. The Fixed Wing category was not represented in the CSS system. In addition, medical treatment of personnel and weapon system crews is presented as a separate category.

Table M-1: Key Weapon Systems by Category

Category	Weapon System
TANK	M1A1 M1A2
AFV	IFV/TOW BSFV LAV AAV
ADA	AVENGER
MLRS	MLRS HIMARS
CANNON	155HIP
HELICOPTERS	AH64D OH58D AH-1

b. The primary maintenance performance measure at the maneuver unit level is availability of unit weapon systems. Availability of unit weapon systems is determined by the current strength of weapon systems at a maneuver unit versus the initial strength less the number of catastrophically killed weapon systems at the same maneuver unit. The number of weapon systems available is a function of many dependent and interdependent factors. These factors can be partitioned into two groups: (1) those factors which render weapon systems inoperable: combat damage and reliability failures and (2) factors that contribute to the return of repaired systems to combat. When more weapon systems are returned to combat, a larger population is available for combat and reliability failure, which in turn workloads the Return-to-Combat (RTC) support system.

(1) Factors, which cause weapon systems to become inoperable, are combat damage and reliability failures. Combat damage is a function of the interaction of opposing forces, resulting in catastrophic kills and reparable battle damage. The percentage of catastrophic kills versus the percentage of reparables varies by weapon system due to threat weapons and survivability characteristics. Table M-2 shows the percent reparable for each system once combat damaged. The percentages are not measures of overall survivability but are conditional results based on a weapon system first being combat damaged. Overall survivability also involves the likelihood of a weapon system being acquired and then being hit by the enemy. The percentages in Table M-2 are, therefore, predicated on the occurrence of these two events. Table M-2 also lists the percentage of organization (AVUM), direct support (AVIM), and general support repair for the weapon systems.

Table M-2: Percent Reparable by Support Echelon

Weapon System	% ORG Repair	% DS Repair	% GS Repair	Total Reparable
M1A1	84	9	0	93
M1A2	84	9	0	93
IFV/TOW	34	47	2	83
BSFV	38	43	2	83
LAV	40	20	0	60
AAV	40	20	0	60
AVENGER	57	10	2	69
MLRS	19	14	28	61
HIMARS	72	2	17	91
155HIP	43	6	0	49
AH64D	23	18	--	41
OH58D	23	18	--	41
AH-1	9	9	--	18

(2) Permanent losses of operational systems can occur in several ways. The most frequent is usually due to catastrophic combat damage. In addition, both types of candidate reparables (combat and reliability) are subject to weapon system abandonment at the maneuver unit or maintenance unit level. Maneuver and maintenance unit abandonment of weapon systems occurs due to immediate war-fight conditions, thus becoming permanent losses like catastrophic kills. Weapon systems can be traveling on an MSR when the scenario ends; thus these weapon systems are not considered part of a combat unit's weapon strength.

Another key factor, which affects availability, is the nonavailability of an owning unit. This occurs when a maintenance unit has repaired systems but does not have a maneuver unit in its area of influence with authorization to accept the system. In some cases, such weapons are never reissued during the scenario. Crewed weapon systems' RTC may be delayed because the appropriate number of crewmembers is not available to operate the weapon system.

All six of these factors {catastrophic damage (k-kills), abandonments (maintenance unit and maneuver unit), currently in transit, unit non-availability, and weapon systems waiting crews} are independent of the CSS system performance. Table M-3 shows the number of systems for each of these categories at the end of the scenario.

(3) Reliability failures are based on mean hours between failures (MHBf) for the major subsystems of each weapon. The major subsystems for this study are Automotive, Armament, Helicopter, and Medical. Of course, the subsystems that fail or are damaged vary by weapon systems (e.g., the M1A2 is composed of both subsystems, automotive and armament, while only automotive is represented for the heavy equipment transporter (HET)). A different mechanic type services each subsystem. In addition, the MHBf can vary by subsystem for each weapon. Helicopters, for this analysis, are serviced by a single type master mechanic although both automotive and armament failures occur for helicopters. In addition, a single medical type treats all wounded/DNBI personnel. The availability and performance of trucks used for resupply is addressed in the supply section of the report.

Table M-3: Weapon System Losses

Weapon	# Weapons Waiting Units	# Weapons Waiting Crews	# Weapons in Transit	Maintenance Unit Abandonments	Maneuver Unit Abandonments	K-Kills	Total
M1A1	0	17	15	0	34	12	78
M1A2	0	4	0	0	0	1	5
IFV/TOW	0	32	0	0	20	15	67
BSFV	0	0	0	0	0	0	0
LAV	0	0	2	0	0	0	2
AAV	0	0	1	0	0	8	9
AVENGER	0	0	1	0	0	5	6
MLRS	0	0	0	0	0	4	4
HIMARS	0	0	0	0	0	0	0
155HIP	0	0	0	0	0	7	7
AH64D	0	2	1	0	0	5	8
OH58D	0	0	0	0	0	0	0
AH-1	0	0	0	0	0	4	4
Total	0	55	20	0	54	61	

(3) Reliability failures are based on mean hours between failures (MHBf) for the major subsystems of each weapon. The major subsystems for this study are Automotive, Armament, Helicopter, and Medical. Of course, the subsystems that fail or are damaged vary by weapon systems (e.g., the M1A2 is composed of both subsystems, automotive and armament, while only automotive is represented for the heavy equipment transporter (HET)). A different mechanic type services each subsystem. In addition, the MHBf can vary by subsystem for each weapon. Helicopters, for this analysis, are serviced by a single type master mechanic although both automotive and armament failures occur for helicopters. In addition, a single medical type treats all wounded/DNBI personnel. The availability and performance of trucks used for resupply is addressed in the supply section of the report.

(4) Factors which influence the RTC of weapon systems are recovery, evacuation, and repair (to include medical treatment of personnel and crews) resources. Each of the CSS resources which performs these services is subject to both combat damage and reliability failure, which determine their availability for weapon system processing and treatment of personnel. Recovery and evacuation are performed on a designated priority basis, while repair and treatment are based on a more complex priority system. Further complicating the impact of repair on weapon system RTC are the repair characteristics of individual weapon systems. These characteristics vary by level of repair (i.e., organization (ORG), direct support (DS), and general support (GS)), and mean time to repair for each type repair (combat, reliability). These characteristics represent a very complex interrelated system, which determines the number of operational weapon systems.

c. Analysis. The maintenance analysis is divided into two sections (Support Services Sufficiency and Key Weapon Availability):

(1) Support Services Sufficiency.

(a) Recovery - Weapons.

1 With two exceptions, recovery operations serviced the recovery workload in a timely manner. "Timely manner" is defined as servicing the recovery workload within two TPs for a given maintenance unit. To meet this criterion the recovery workload at the end of one TP must be serviced in the next time period. The reason for this explanation of "timely manner" is to account for the maximum time of 96 minutes it takes for a recovery vehicle to assist in the recovery of a damaged weapon system or vehicle. If a vehicle requires an assisted recovery during the last half of the current TP, that vehicle would not reach the designated maintenance area until the next TP. The two recovery vehicles modeled are the improved recovery vehicle (M88) and a generic recovery vehicle (HMTWRECKER) which represent all other recovery vehicles, which are not M88s. Table M-4 provides an overview of both recovery vehicles' status for the scenario where:

Initial Strength (Initial Str) is the assigned density at the start of the scenario.

Average Strength (AVG) is the expected number operational throughout the scenario.

Lowest Strength (LOW) is the smallest number operational within any TP.

Highest Strength (HIGH) is the largest number operational within any TP.

Table M-4: M88 and HMTWRECKER Availabilities

M88					HMTWRECKER				
Unit ID	Initial Str	AVG	LOW	HIGH	Unit	Initial Str	AVG	LOW	HIGH
B00000	10	10	10	10	B000AH	6	6	6	6
B000AH	3	3	3	3	B01CSA	103	102	102	103
B01CSA	49	48	47	49	B201AH	6	6	6	6
B20002	15	15	15	15	B20DSA	33	33	33	33
B200MX	1	1	1	1	B210AR	6	6	6	6
B201AH	3	3	3	3	B210EN	6	6	6	6
B20DSA	15	15	14	15	B211AR	6	6	6	6
B210AR	2	2	2	2	B212AR	6	6	6	6
B210EN	1	1	1	1	B213MX	6	6	6	6
B211AR	2	2	2	2	B21BSA	40	40	40	40
B212AR	2	2	2	2	B220AR	6	6	6	6
B213MX	1	1	1	1	B220EN	6	6	6	6
B21BSA	17	17	16	17	B221AR	6	6	6	6
B220AR	2	2	2	2	B222AR	6	6	6	6
B220EN	1	1	1	1	B223MX	6	6	6	6
B221AR	2	2	2	2	B224MX	6	6	6	6
B222AR	2	2	2	2	B22BSA	31	31	31	31
B223MX	1	1	1	1	B230AR	6	6	6	6
B224MX	1	1	1	1	B230EN	6	6	6	6
B22BSA	14	14	13	14	B231AR	6	6	6	6
B230AR	2	2	2	2	B232AR	6	6	6	6
B230EN	1	1	1	1	B233MX	6	6	6	6
B231AR	2	2	2	2	B23BSA	28	28	28	28
B232AR	2	2	2	2	B50SSA	15	15	15	15
B233MX	1	1	1	1	B511EN	6	6	6	6
B23BSA	9	9	9	9	B511MX	6	6	6	6
B50000	1	1	1	1	B513IN	3	3	3	3
B50SSA	8	8	8	8	B514AR	6	6	6	6
B510MX	6	6	6	6					
B511EN	1	1	1	1					
B511MX	3	3	3	3					
B513IN	1	1	1	1					
B514AR	3	3	3	3					

2 Table M-5 lists the recovery workload for all maintenance units by recovery vehicle type.

Table M-5: M88 and HMTWRECKER Recovery Workloads

Maintenance Unit	Recovered by			Maintenance Unit	Recovered by		
	HMTWRECKER	M88	TOTAL		HMTWRECKER	M88	TOTAL
B00000	0	3	3	B223MX	0	5	5
B000AH	1	1	2	B224MX	0	5	5
B01CSA	351	3	354	B22BSA	2	1	3
B20002	0	17	17	B230AR	1	1	2
B200MX	0	15	15	B230EN	0	13	13
B201AH	1	1	2	B231AR	4	14	18
B20DSA	14	1	15	B232AR	4	21	25
B210AR	15	2	17	B233MX	2	7	9
B210EN	0	14	14	B23BSA	2	1	3
B211AR	0	26	26	B50000	0	1	1
B212AR	3	28	31	B50SSA	1	1	2
B213MX	1	20	21	B510MX	0	2	2
B21BSA	2	2	4	B511EN	1	15	16
B220AR	1	1	2	B511MX	2	6	8
B220EN	0	13	13	B513IN	0	0	0
B221AR	0	5	5	B514AR	3	10	13
B222AR	0	5	5				

3 Recovery operations by M88s for the vehicles and weapon systems organic to the division headquarters' (HQ) area (unit B200MX) and the 3rd mechanized infantry battalion of the 1st brigade (unit B213MX) are listed in Table M-6.

a M88 recovery operations in the division area were not performed in a timely manner. At the end of TP 4 seven vehicles and weapon systems needed to be recovered to the main support battalion (MSB), five of which were IFV/TOWs and one M1A2. At the end of TP 5, three of the IFV/TOWs and the single M1A2 still needed to be recovered. These systems were recovered to the MSB before the scenario concluded at hour thirty.

b The single M88 at the 3rd battalion's recover team could not handle the recovery workload early in the scenario. At the end of TP 1, four M1A2s, three IFV/TOWs, and one M113 needed to be recovered to this battalion's maintenance facility. The M88 responsible for recovering these weapon systems could recover only two M1A2s and one IFV/TOW within the 2nd four hour TP. By the end of TP 4, this unit was able to recover the workload in a timely manner and this carried on for the remainder of the scenario.

Table M-6: M88 Recoveries by the MSB and 3rd Battalion

TP	1	2	3	4	5	6	7
	B200MX						
# REC.	1	1	1	3	3	3	2
WAITING REC.	0	0	1	7	4	2	0
	B213MX						
# REC.	3	3	3	3	3	3	2
WAITING REC.	8	6	3	1	4	2	0

#### 4 Conclusion:

The M88 recovery operations in the two above-mentioned units were hampered by the lack of recovery vehicles. An additional two or more M88s strategically located within these units would have alleviated these recovery problems.

##### (b) Recovery - Personnel.

The recovery of injured personnel is implied; therefore, injured personnel do not require a recovery vehicle for transport from the battlefield to a medical facility. This phenomenon negates the possibility of a backlog of injured personnel needing recovery. Hence, recovery assets will never impede personnel RTD as far as the present sort of modeling effort is concerned.

##### (c) Evacuation - Weapons.

1 HETs and a generic evacuation vehicle perform evacuation support in the scenario. The purpose of the generic evacuation vehicle is to represent the backhaul capability of other transporters. The analysis focuses on the HETs because they are considered potential constraints on evacuation. All but four of the key weapon systems utilize HETs for evacuation. The exceptions are AH64D, OH58D, AH-1, and the AVENGER. Only the performance of HETs is addressed. Weapon system evacuations are performed in a "timely manner" if damaged weapon systems are evacuated to the designated area (corps or division) within two TPs of the sustained damage.

2 Evacuation in this scenario is supported at the division area (unit B200MX) and at the corps forward area (unit B00000) with 15 and 60 HETs assigned, respectively. Evacuations occur for two reasons:

- designation of maintenance support at higher support levels.
- maintenance overflow (maintenance overflow occurs when the number of hours needed to repair awaiting weapon systems exceeds a maintenance man-hour threshold set for a maintenance unit).

3 Across the scenario, at least 90 percent of the corps and division area's HETs were available at any given TP.

4 There were 228 vehicle and weapon system evacuations to the corps area, which required a HET (refer to Table M-7). These vehicles and weapon systems included 171 M113s, 34 M1A1s, and 20 IFV/TOWs. As shown in Table M-7, not all of these systems were evacuated to the corps area in a timely manner. At the end of TP 2, 92 systems required a HET for transport. It took an additional nine hours to evacuate these vehicles to the corps area. During this portion of the scenario, the number of weapon systems damaged was immense due to the combat intensity. These 92 systems were evacuated gradually as the scenario progressed.



Table M-7: HET Evacuations to the Corps Area

TP	1	2	3	4	5	6	7
# EVAC.	8	34	40	42	62	30	13
WAITING EVAC.	39	92	96	69	38	18	13

5 Conclusion:

Time-distance factors and the magnitude of the workload produced by the scenario hampered the corps from evacuating the necessary vehicles and weapon systems to the CSA. As shown in Table M-7, the backlog of vehicles requiring evacuation was depleted before the scenario ended but not in a timely manner.

(d) Evacuation - Personnel.

1 Injured personnel evacuation is performed in the scenario by ambulance. Injured personnel have to be evacuated to a higher echelon for treatment when they have sustained either combat damage or DNBI of a severe nature. Personnel evacuations are performed in a "timely manner" if the injured personnel are evacuated before their wounds become fatal from receiving no treatment.

2 Ground evacuation is supported at the corps area by unit B00000 and at the division area by unit B200MX.

3 The corps has 64 ambulances and the division has 48 ambulances for personnel evacuations. Damage to these ambulances is negligible during the course of the scenario. An ambulance can transport four injured personnel in one trip.

4 There were 814 injured personnel evacuated to the corps support area (CSA) during the scenario. Another 1339 injured persons were waiting for an ambulance at the end of the scenario. The reason for this was the Army's CSA was being used by the Green forces (Kuwaiti and Saudi) for treatment of their injured personnel. The CSA's ambulances could not handle this additional workload. The twelve personnel evacuations to the DSA were completed in a timely manner.

5 Conclusion:

The injured person workload produced by this scenario could not be handled by the CSA. A lack of Host Nation Support (HNS) ambulances was the main factor for this shortfall.

(e) Repair - Ground Based Weapons.

1 Sufficient repair support is determined by the availability of required mechanic types at the supporting maintenance facility. Table M-8 shows, for assigned mechanics, the maximum MMH percentage

utilized for each of the 36 maintenance facilities across the scenario. When this percentage is 100 sufficient mechanics were not available to service the workload at some point during the scenario.

2 There is one exception to the above described 100 percent indicator - maintenance backlog overflow. Resource status is reported only at the end of a TP thus making it possible that 100 percent utilization occurred within the TP but shows less at the end of the TP due to completion of repairs. So the condition can exist where the ending TP utilization is less than 100 percent but within TP conditions existed that caused maintenance backlog overflow.

3 In general, for those facilities with less than 100 percent utilization at the end of a TP, sufficient maintenance resources were always available. There were only minor exceptions when very small fractional workloads were evacuated due to backlog status and the MMH utilization was not 100 percent. Any under-utilized resources are not necessarily "excesses" but are indicators of the magnitude of the workload for this scenario. Force structure implications are not addressed in this report.

Table M-8: Utilization and Initial Strength by Maintenance Unit

Unit Name	Armament		Automotive		Helicopter		Medical	
	Util. %	Str.	Util. %	Str.	Util. %	Str.	Util. %	Str.
B00000	16	96	4	144	53	53	22	138
B000AH	0	1	15	6	23	21	32	7
B01CSA	0	3	100	10			71	6
B20002	68	11	100	24			100	6
B200MX	34	32	47	48	15	53	100	46
B201AH	0	1	15	6	32	21	32	7
B20DSA	0	2	39	10			71	6
B210AR	100	23	55	106			100	48
B210EN	9	5	57	24			55	6
B211AR	77	21	62	45			68	11
B212AR	75	21	68	45			68	11
B213MX	61	22	36	60			74	11
B21BSA	0	1	100	1			100	3
B220AR	33	23	14	106			68	48
B220EN	9	5	55	24			46	6
B221AR	29	21	9	45			47	11
B222AR	24	21	8	45			52	11
B223MX	22	22	6	60			54	11
B224MX	17	22	6	60			54	11
B22BSA	0	1	100	1			100	3
B230AR	100	23	27	106			100	48
B230EN	9	5	55	24			51	6
B231AR	100	21	47	45			60	11
B232AR	93	21	67	45			51	11
B233MX	45	22	8	60			53	11
B23BSA	0	1	100	1			100	3
B50000	28	32	6	48	4	53	100	46
B500AH	0	1	0	6	14	21	48	7
B501CH	0	1	0	6	32	44	61	7
B50SSA	0	3	14	10			71	6
B510MX	85	23	14	106			100	48
B511EN	11	5	68	24			75	6
B511MX	19	22	6	60			46	11
B512MX	9	22	0	60			46	11
B513IN	11	1	16	1			75	6
B514AR	29	21	8	60			44	11

4 Figures M-1 and M-2 show the MMH utilization by mechanic type for those maintenance units with 100 percent utilization.

a In the US Army units, the armament mechanics in two (B210AR and B230AR) of the three forward support battalions (FSBs) and one maneuver battalion (B231AR) were 100 percent utilized for at least one TP during the scenario. The armament mechanics' utilization for these three maintenance units is illustrated in Figure M-1.

- The armament mechanics in the 1st brigade's FSB (unit B210AR) were fully utilized in TP 3. During TP 3, this FSB was repairing vehicles and weapon systems damaged during the first two TPs. There was never a build-up of unserviced vehicles and weapon systems requiring armament repair. Similar situations occurred for the other two maintenance units with 100 percent armament mechanic utilization. No maintenance overflow occurred in these three maintenance units.

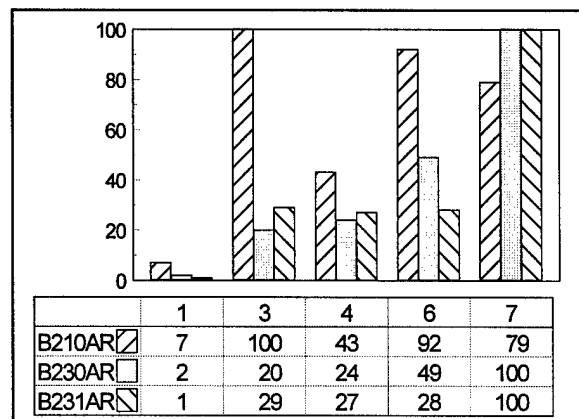


Figure M-1: Armament Mechanic Utilization

b In the US Army units, the only maintenance unit that had automotive mechanic over-utilization problems was the org level maintenance facility supporting the division artillery units (unit B20002). The automotive mechanic utilization in this unit is graphically represented in figure M-2.

- The automotive mechanics in this maintenance facility used all MMH available in TP 7. At the end of TP 7, three 155HIPs, two FAASVs, one MLRS, and one M88 were waiting for automotive mechanics to become available at this maintenance facility. No maintenance overflow occurred at this unit.

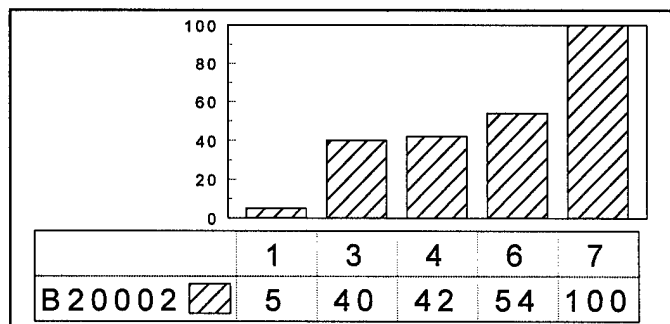


Figure M-2: Automotive Mechanic Utilization (DIVARTY)

## 5 Conclusion:

Although there were four instances of mechanics becoming fully utilized, there was never a major backlog of unserved vehicles and weapon systems. Maintenance overflow was also non-existent within the US Army maintenance units. These two factors indicate that mechanic resources did not constrain weapon system availability.

### (f) Repair - helicopters.

Note: The AH64D, OH58D, and the AH-1 are the systems represented by the helicopter weapon system category.

1 Sufficient helicopter repair support is determined by the availability of required helicopter mechanics at the supporting maintenance facility. The number of helicopter mechanics assigned to the helicopter battalions, the corps area, and division area can be found in Table M-8. Note from these tables that none of the helicopter maintenance facilities had their mechanics 100 percent utilized during any TP of the scenario.

2 Recovery - Reference assumption 3.d. for the recovery of damaged helicopters.

3 Evacuation - The AH64D, OH58D, and AH-1 do not require a HET for evacuation. Instead, a generic evacuation vehicle is used to evacuate these systems. The availability of HETs does not hamper the process of helicopter evacuation.

## 4 Conclusion:

None of the three maintenance functions (recovery, evacuation, and repair) restricted helicopter RTC during the scenario.

(g) Medical treatment.

1 Personnel can be in one of the following three categories: combat ready, in the medical treatment process, or KIA. When injured personnel arrive at a medical facility, they receive treatment immediately, have to wait for the next available medic, or have to be evacuated to a higher echelon because of the severity of the wound. After treatment, injured personnel are returned to their respective unit. At TP 7, the theater's Blue troop force was at 96 percent, its lowest availability during any TP of the scenario. The KIA column is the cumulative blue troop losses over the scenario.

Table M-9: Theater Personnel Profile

TP	Combat Ready	Being Treated	KIA	% AVAIL
0	35,283	0	0	100
1	33,833	1,266	185	96
2	33,932	1,167	185	97
3	34,349	750	185	98
4	34,316	763	204	98
5	34,070	983	230	97
6	33,799	1,172	312	97
7	33,303	1,486	495	96

2 During the course of the scenario, the majority of personnel that are not combat ready are being treated or awaiting treatment at the 1st brigade's FSB (during TP 7 there were 351 soldiers waiting for treatment at this facility).

3 Conclusion:

With the one exception stated above, availability of medical teams organic to echelons lower than division did not constrain personnel RTC.

(2) Key Weapon Availability.

(a) Up to this point the analysis has addressed individual CSS support services (recovery, evacuation, repair, medical treatment) and their impact on RTC. With the exceptions noted, for the most part each of these support services was sufficient for the available workloads.

(b) The following section of the report, in effect, examines the cumulative effects of CSS services by looking at the availability of key weapons. Tables C-1 through C-13 in appendix C provide unit level overviews for each key weapon system.

1 Each table (C-1 through C-13) contains the following information:

-Initial Strength (Str) - weapon system density at the start of the scenario.

-End Strength (Str) - weapon system density at the end of the scenario.

-Permanent Losses (K-kills) - catastrophic kills and abandonments.

-End % availability - weapon system availability at the end of the scenario. This availability calculation excludes permanent losses in conformance with the earlier described sufficiency criteria. Permanent losses are excluded because their occurrence is independent of how well (or poorly) CSS performs.

-Average availability (Avg) - the average number of weapon systems available based on the number available per TP for the entire scenario.

-Lowest availability (Low) - the smallest number of weapon systems available based on the number available per TP for the entire scenario.

-Highest availability (High) - the largest number of weapon systems available based on the number available per TP for the entire scenario.

2 Two phenomena appearing in tables in Appendix C warrant discussion:

a A "dead unit" is indicated when the "end strength" and "availability" are zero. A "dead unit" occurs when significant unit resources are decimated and that unit can no longer effectively function. Its surviving resources, damaged and undamaged, are distributed to repair or other units requiring weapons, respectively. The row in each table for dead units is shaded.

b One would expect the "end strength" to always be smaller than initial strength if there were permanent losses. This is not always the case because of the need-based reissue of repaired (and crewed) weapons. Depending on the current available strength of a weapon, reissues are distributed proportionally higher to those units with the greatest need (lowest current strength) and not to the unit which originally "owned" the weapon.

(c) Results:

- The two major weapon systems for the ground forces (M1A1 and IFV/TOW) had instances where the ending availability was below 80 percent. For the M1A1, six units (B211AR, B213MX, B231AR, B233MX, B511MX, and B514MX) had an ending availability of less than 80 percent. From the previous sections of this maintenance analysis, the leading factor for the low availability of M1A1s can be found in Table M-3. At the end of the scenario, there were 17 M1A1s combat ready but could not be utilized because of a lack of available crewmembers. When these systems are manned, an additional 17 systems would bring the availability percentage up past 80 percent for the six units listed above.

- The ending availability of the IFV/TOWs at the following units was below the 80 percent mark: B201DC (76 percent), B232AR (76 percent), B212AR (67 percent), B233MX (63 percent), B211AR (48 percent), B231AR (39 percent), B203DC (0 percent), and B213MX (0 percent). Similar to the M1A1 crew shortage, at the end of the scenario, 32 IFV/TOWs were operational but crews were not available to

man these systems. Given this situation, there were enough IFV/TOWs waiting for crews that would push these units' ending availability well above the 80 percent mark.

3 Neither the US Army nor the Marine Expeditionary Force had any units destroyed during the scenario. Appendix D lists the combat ineffective ("dead") units for the GREEN forces.

(3) CSS Workloads. The following CSS workloads are provided to show the type and magnitude of workload serviced by each unit.

(a) Recovery and evacuation vehicle workload. The second and third columns in Table M-10 indicate the number of vehicles that required assisted recovery from their owning unit. The fourth through seventh columns show the number of vehicles that required evacuation 'in' and 'out' of a higher echelon maintenance unit; also indicated is whether or not the vehicle required a HET for evacuation.

Table M-10: Recovery and Evacuation Workload

Maint Unit	Total # of assisted recoveries		# EVAC'D IN		# EVAC'D OUT	
	HMTWRECKER	M88	TOTAL	w/ HET	TOTAL	w/ HET
B00000	0	3	34	14	0	0
B000AH	1	1	0	0	7	0
B01CSA	351	3	0	0	0	0
B20002	0	17	0	0	0	0
B200MX	0	15	12	0	0	0
B201AH	1	1	0	0	12	0
B20DSA	14	1	0	0	0	0
B210AR	28	51	0	0	0	0
B210EN	0	14	0	0	5	3
B211AR	0	26	0	0	17	16
B212AR	3	28	0	0	17	13
B213MX	1	20	0	0	17	15
B21BSA	2	2	0	0	5	1
B220AR	8	15	0	0	0	0
B220EN	0	13	0	0	5	2
B221AR	0	5	0	0	3	3
B222AR	0	5	0	0	3	3
B223MX	0	5	0	0	3	3
B224MX	0	5	0	0	3	3
B22BSA	2	1	0	0	5	1
B230AR	16	36	0	0	0	0
B230EN	0	13	0	0	5	3
B231AR	4	14	0	0	16	12
B232AR	4	21	0	0	16	11
B233MX	2	7	0	0	11	9
B23BSA	2	1	0	0	3	0
B50000	0	1	2	0	0	0
B500AH	0	0	0	0	0	0
B501CH	0	0	0	0	2	0
B50SSA	1	1	0	0	0	0
B510MX	0	2	45	13	0	0
B511EN	1	15	0	0	7	4
B511MX	2	6	0	0	10	3
B512MX	0	0	0	0	9	2
B513IN	0	0	0	0	9	0
B514AR	3	10	0	0	9	3

(b) Medical team workload. Table M-11 shows the number of personnel that arrived at a medical facility during the scenario due to combat and non-combat (DNBI) actions. The column titled '# EVAC'D TO THIS UNIT' lists the quantity of injured personnel evacuated to the corresponding medical facility for treatment. The 'MMH EXPENDED' displays the number of treatment man-hours expended by all medical teams.

Table M-11: Medical Unit Workload

MEDICAL UNIT	CBT MEDICAL RECOVERED	DNBI MEDICAL RECOVERED	# EVAC'D TO THIS UNIT	MMH EXPENDED	MEDICAL UNIT	CBT MEDICAL RECOVERED	DNBI MEDICAL RECOVERED	# EVAC'D TO THIS UNIT	MMH EXPENDED
B00000	11	80	814	288	B224MX	0	35	0	50
B000AH	0	15	0	24	B22BSA	0	28	0	31
B01CSA	0	15	0	39	B230AR	2	13	141	303
B20002	87	116	0	75	B230EN	0	15	0	24
B200MX	50	132	4	428	B231AR	96	31	0	48
B201AH	0	15	0	24	B232AR	53	31	0	46
B20DSA	0	15	0	39	B233MX	13	35	0	50
B210AR	13	13	408	365	B23BSA	0	28	0	30
B210EN	0	17	0	26	B50000	49	183	9	479
B211AR	154	27	0	45	B500AH	8	16	0	26
B212AR	127	25	0	43	B501CH	0	19	0	39
B213MX	189	25	0	45	B50SSA	0	15	0	39
B21BSA	0	28	0	30	B510MX	39	49	257	322
B220AR	0	13	39	242	B511EN	40	19	0	32
B220EN	0	14	0	22	B511MX	5	28	0	42
B221AR	0	33	0	44	B512MX	31	27	0	43
B222AR	0	34	0	48	B513IN	90	24	0	38
B223MX	0	36	0	50	B514AR	83	30	0	42

(c) Maintenance team workload. Table M-12 shows the number of vehicles (both ground and air) that were recovered to a maintenance facility during the scenario. The last four columns display the number of maintenance man-hours expended on ground and air vehicles and the estimated number of maintenance man-hours required at TP 7 to repair all vehicles at the maintenance facilities.



Table M-12: Maintenance Unit Workload

MAINT UNIT	# VEHICLES RECOVERED		GROUND VEHICLES		HELICOPTERS	
	CBT DAMAGE	RAM DAMAGE	MMH EXPENDED	MMH NEEDED	MMH EXPENDED	MMH NEEDED
B00000	24	40	124	53	198	3
B000AH	8	21	6	7	38	0
B01CSA	0	354	102	491		
B20002	15	12	184	162		
B200MX	18	17	178	100	52	1
B201AH	10	20	6	7	38	0
B20DSA	0	15	30	19		
B210AR	19	3	380	262		
B210EN	0	16	81	73		
B211AR	54	11	179	27		
B212AR	53	9	190	7		
B213MX	39	9	118	10		
B21BSA	0	9	8	9		
B220AR	0	3	139	116		
B220EN	0	14	79	72		
B221AR	0	17	69	13		
B222AR	0	15	59	11		
B223MX	0	15	58	10		
B224MX	0	13	48	8		
B22BSA	0	8	8	5		
B230AR	1	3	208	171		
B230EN	0	15	80	73		
B231AR	38	13	125	26		
B232AR	42	14	168	14		
B233MX	20	14	69	34		
B23BSA	0	6	8	9		
B50000	32	11	55	64	19	6
B500AH	0	4	0		22	1
B501CH	0	13	0		110	43
B50SSA	0	3	11	10		
B510MX	7	17	145	151		
B511EN	4	16	85	68		
B511MX	24	9	38	32		
B512MX	19	5	13	17		
B513IN	16	2	2	15		
B514AR	26	13	64	63		

(4) Observations.

No CSS support services hindered the availability of any weapon systems. There were minor delays with respect to recovery vehicles and repair teams, but these delays were too inconsequential to consider them shortfalls in the CSS system.

## 6. Supply Analysis.

a. This analysis assesses the CSS system's capability to support combat and combat support units for the defined scenario excursion. The CSS units must fill requests for replenishment stockages in a "timely fashion"; failure to do so can be attributed to lack of transporters, lack of stockages, long order-to-delivery times, or a combination of all three.

b. Analysis. This analysis is structured into two parts: supply class IIIB and supply class V.

### (1) Supply Class IIIB.

(a) Utilization. For the scenario excursion, the usage of class IIIB (petroleum) was found by summing the utilization (quantities "used" plus quantities "destroyed") of all maneuver units during each TP. Calculated in gallons (gals), the utilization of class IIIB for the length of the scenario is presented in table L-1, table L-2, and table L-3 for the Corps, Division, and MEF (respectively).

The utilization of supplies generates a requirement for stocks of supply types as well as transportation assets to deliver the replenishments to maneuver unit stockages. Each order levies upon the CSS system a requirement for existing stocks and transportation assets. The authorized amount declines with time due to the attrition of weapon systems. Each weapon system has an authorized amount of specific supply types, and the authorized stockage is reduced as systems are destroyed. Tables L-1, L-2, and L-3 identify the stockage levels and activities for class IIIB: 1) amounts used; 2) amounts destroyed; and 3) amounts utilized (the requirement). Reference Appendix B for definitions of "amount used" and "amount destroyed".

Table L-1: Utilization of Class IIIB, Gals (Corps Units)

TP	Amount Used	Amount Destroyed	Utilization
0	0	0	0
1	196	0	196
2	220	0	220
3	1,457	0	1,457
4	278	0	278
5	784	617	1,401
6	639	0	639
7	168	0	168
8	166	0	166
Total	3,908	617	4,525

Table L-2: Utilization of Class IIIB, Gals (Division Units)

TP	Amount Used	Amount Destroyed	Utilization
0	0	0	0
1	13,185	27	13,212
2	3,278	0	3,278
3	2,006	50	2,056
4	2,120	1,371	3,491
5	3,109	1,090	4,199
6	2,882	1,125	4,007
7	1,935	254	2,189
Total	28,515	3,917	32,432

Table L-3: Utilization of Class IIIB, Gals (MEF Units)

TP	Amount Used	Amount Destroyed	Utilization
0	0	0	0
1	1,166	0	1,166
2	575	0	575
3	755	0	755
4	950	0	950
5	1,085	0	1,085
6	820	0	820
7	944	603	1,547
Total	6,295	603	6,898

(b) Discussion. The resupply options for maneuver units are: 1) resupply is unnecessary (Balance-on-Hand  $\geq 75\%$  of Authorized); 2) standard resupply (Balance-on-Hand  $\geq 50\%$  &  $< 75\%$  of Authorized); or 3) emergency resupply (Balance-on-Hand  $< 50\%$  of Authorized); reference Appendix B for definitions of "standard" and "emergency" resupply.

- **Balance-on-Hand ( $\geq 75\%$ )** of Authorized: Initially all units start in this range since the Balance-on-Hand is equal to the Amount Authorized. BOH, which remain in this range, maintain a sufficient quantity of authorized munitions and at no time throughout the scenario require supply replenishment.
- **Balance-on-Hand (50%-74%)** of Authorized: This column indicates whether or not the BOH by munition type at any unit fell to the indicated percentage range of the authorized amount. BOH in this range triggers "standard supply replenishment" requests.
- **Balance-on-Hand (0%-49%)** of Authorized: This column indicates whether or not the BOH by munition type at any unit fell to the indicated percentage range of the authorized amount. BOH in this range triggers "emergency and standard supply replenishment" requests.
- **Zero Balance-on-Hand:** This column indicates whether or not the BOH by munition type at any unit fell to zero.

Table L-4 indicates during which TP(s) any maneuver unit(s) may have a Balance-on-Hand (BOH) so low as to warrant the use of either standard or emergency resupply.

Table L-4: Resupply Options, Class IIIB

Resupply	TP							
	0	1	2	3	4	5	6	7
Unnecessary	69	69	66	66	68	68	68	69
Standard	0	0	3	3	1	1	1	0
Emergency	0	0	0	0	0	0	0	0
All Units	69	69	69	69	69	69	69	69
COMBAT INEFFECTIVE (DEAD) UNITS ARE NOT INCLUDED.								

For more detail on individual maneuver units requiring resupply see Table L-5. These Corps, Division, and MEF units wait an average of 1.29 TPs (approximately 5 hours, 14 minutes) with a median of 1 TP (four hours), before their BOH returns to a level no longer requiring resupply of class IIIB.

Table L-5: Percentage of Balance On-Hand for Maneuver Units  
Requiring Resupply, Class IIIB

Unit	TP								#TPs
	0	1	2	3	4	5	6	7	
B201A2				68					1
B203A2			66	54					2
B211AR			66						1
B212AR			68						1
B213MX				74					1
B500AH							70		1
B501CH					69	62			2
TOTAL	0	0	3	3	1	1	1	0	

For example, at the end of TP 3, B201A2 had a class IIIB BOH of 68 percent. This was the only TP in which B201A2 could have asked for resupply. During TP 3, B201A2 was one of three units that requested resupply.

(c) Problems. Table L-5 shows the BOH percentage for individual maneuver units requiring resupply, however, there were no problems filling maneuver unit orders for class IIIB.

(d) Observations.

(1) There was no emergency replenishment of supply class IIIB required by any of the 69 maneuver units in any TP.

(2) There were no problems filling maneuver unit order requests for supply class IIIB.

(2) Supply Class V.

(a) Utilization. For the scenario, the utilization of class V (ammunition) was found by summing the utilization (quantities "used" plus quantities "destroyed") of all maneuver units during each of the 4-hour TPs. Calculated in short tons (stons), the utilization of class V for the length of the scenario is presented in Tables L-6, L-7, and L-8 for the Corps, Division, and MEF (respectively).

Table L-6: Utilization of Class V, STONS (Corps Units)

TP	USED STONS	DESTROYED STONS	UTILIZATION
0	0	0	0
1	230	0	230
2	120	493	613
3	128	0	128
4	285	0	285
5	147	3	150
6	185	0	185
7	169	0	169
TOTAL	1264	496	1760

Table L-7: Utilization of Class V, STONS (Division Units)

TP	USED STONS	DESTROYED STONS	UTILIZATION
0	0	0	0
1	954	16	970
2	71	371	442
3	124	1	125
4	230	18	248
5	219	34	253
6	304	33	337
7	307	32	339
TOTAL	2209	505	2714

Table L-8: Utilization of Class V, STONS (MEF Units)

TP	USED STONS	DESTROYED STONS	UTILIZATION
0	0	0	0
1	0	0	0
2	0	0	0
3	0	0	0
4	0	0	0
5	0	0	0
6	23	0	23
7	81	20	101
TOTAL	104	20	124

- Tables L-9, L-10, and L-11 depict the class V utilization (in rounds) for the Corps, Division, and MEF maneuver units by munition type for each TP in the scenario.

- A list of all Corps, Division, and MEF assets listing VIC unit name designators and their actual unit names is contained in Appendix A.

- Table L-9 identifies the utilization of class V by munition type for the 21<sup>st</sup> Corps MLRS Battery (B000M2), the 21<sup>st</sup> Corps HIMARS Battery (B001M2), and the 21<sup>st</sup> Corps Apache Attack Helicopter Battalion (B000AH) at the end of each TP in the scenario.

Table L-9: Utilization of Class V by Munition Type and Unit per TP (Corps)

TP	UNIT NAME	MUNITION TYPE	ROUNDS USED	ROUNDS DESTROYED	UTILIZATION
1	B000M2	ATACMS	230	0	230
2	B000M2	ATACMS	20	116	136
2	B001M2	ATACMS	14	4	18
2	B000M2	MLRS	0	7	7
2	B001M2	MLRS	0	3	3
3	B000M2	ATACMS	25	0	25
3	B001M2	ATACMS	22	0	22
4	B000M2	ATACMS	31	0	31
4	B001M2	ATACMS	18	0	18
4	B000AH	Longbow	86	0	86
5	B000M2	ATACMS	33	0	33
5	B000AH	Longbow	35	22	57
5	B000AH	B30MM	55	1,440	1,495
6	B000M2	ATACMS	7	0	7
6	B001M2	ATACMS	4	0	4
6	B000AH	Longbow	28	0	28
7	B000M2	ATACMS	12	0	12
7	B000M2	MLRS	36	0	36
7	B000AH	Longbow	64	0	64
		TOTAL	720	1,592	2,312

- Table L-10 identifies the utilization of class V for the 23<sup>rd</sup> Division maneuver units by munition type at the end of each TP in the scenario.

Table L-10: Utilization of Class V by Munition Type and Unit per TP (Division)

TP	UNIT NAME	MUNITION TYPE	USED	DESTROYED STONS	UTILIZATION
1	B200M2	ATACMS	28	0	28
1	B201A2	155MM	0	29	29
1	B202A2	155MM	0	32	32
2	B200M2	ATACMS	20	90	110
2	B200M2	MLRS	0	6	6
2	B201AH	LONGBOW	38	1	39
3	B200M2	ATACMS	39	0	39
3	B200SH	HELLFIRE	24	0	24
3	B201AH	LONGBOW	155	22	177
3	B201A2	155MM	12	0	12
3	B202A2	155MM	12	0	12
3	B203A2	155MM	12	0	12
4	B200M2	ATACMS	26	0	26
4	B201A2	155MM	257	9	266
4	B202A2	155MM	143	0	143
4	B203A2	155MM	144	0	144
4	B207A2	155MM	12	0	12
4	B209A2	155MM	12	0	12
5	B200M2	ATACMS	20	0	20
5	B200SH	HELLFIRE	8	0	8
5	B201A2	155MM	907	128	1,035
5	B202A2	155MM	360	29	389
5	B203A2	155MM	144	0	144
5	B207A2	155MM	189	1	190
5	B208A2	155MM	176	0	176
5	B209A2	155MM	144	0	144
6	B200M2	ATACMS	32	0	32
6	B200SH	HELLFIRE	11	1	12
6	B201A2	155MM	109	22	131
6	B202A2	155MM	13	0	13
6	B203A2	155MM	13	0	13
6	B204A2	155MM	12	0	12
6	B205A2	155MM	12	0	12
6	B206A2	155MM	12	0	12
6	B207A2	155MM	141	146	287
6	B208A2	155MM	174	0	174
6	B209A2	155MM	110	0	110
6	B201AH	LONGBOW	153	3	156
7	B200M2	ATACMS	36	0	36
7	B200SH	HELLFIRE	7	1	8
7	B201A2	155MM	159	4	163
7	B202A2	155MM	60	0	60
7	B203A2	155MM	110	0	110
7	B204A2	155MM	260	0	260
7	B205A2	155MM	260	0	260
7	B206A2	155MM	208	0	208
7	B207A2	155MM	193	154	347
7	B208A2	155MM	208	0	208
7	B209A2	155MM	225	0	225
		TOTAL	5,400	678	6,078

- Table L-11 identifies the utilization of class V for the MEF maneuver units by munition type at the end of each TP. Although the MEF was part of the modeled force in this scenario; it receives logistics from the MEF Service Support Group and did not impact the Army CSS system.

Table L-11: Utilization of Class V by Munition Type and Unit per TP (MEF)

TP	UNIT NAME	MUNITION TYPE	USED STONS	DESTROYED STONS	UTILIZATION
1	-	-	-	-	-
2	-	-	-	-	-
3	-	-	-	-	-
4	-	-	-	-	-
5	-	-	-	-	-
6	B500AH	TOWII	96	0	96
6	B512RE	TOWII	0	1	1
6	B500AH	B20MM	265	0	265
6	B51AT2	155MM	90	0	90
6	B51BT2	155MM	70	0	70
6	B51CT2	155MM	70	0	70
7	B51AT2	155MM	222	25	247
7	B51BT2	155MM	242	28	270
7	B51CT2	155MM	246	10	256
7	B500AH	B20MM	104	1492	1596
7	B511MX	STINGER	0	2	2
7	B512MX	STINGER	0	2	2
7	B513IN	STINGER	0	4	4
7	B514AR	STINGER	0	3	3
7	B521IN	STINGER	0	4	4
7	B523IN	STINGER	0	2	2
7	B500AH	TOWII	4	15	19
7	B511MX	TOWII	42	2	44
7	B512MX	TOWII	0	3	3
7	B513IN	TOWII	31	1	32
7	B514AR	TOWII	32	0	32
7	B521IN	TOWII	31	1	32
7	B522IN	TOWII	26	0	26
7	B523IN	TOWII	25	2	27
7	B512MX	JAVELIN	0	1	1
7	B513IN	JAVELIN	0	3	3
7	B514AR	JAVELIN	0	1	1
7	B521IN	JAVELIN	63	1	64
7	B523IN	JAVELIN	11	1	12
7	B511MX	120MM	2	15	17
7	B514AR	120MM	211	126	337
7	B511MX	60MM	72	1	73
7	B513IN	60MM	0	24	24
7	B514AR	60MM	0	5	5
7	B521IN	60MM	0	9	9
7	B523IN	60MM	0	7	7
		TOTAL	1,955	1,791	3,746

(b) Discussion.

(1) This analysis focuses on 19 munition types {155MM, ATACMS, MLRS, Hellfire, Longbow, 2.75RKT, Patriot, Stinger, 120MM, 60MM, 25MM, 40MM, B30MM, 7.62MM, 5.56MM, 50CAL, Javelin, LAW, and TOWII} using five indices {Amount Authorized, Amount On-Hand, Amount Used, Amount

Destroyed, and Ratio of Amount On-Hand to Amount Authorized}. A list of all supply analysis definitions is contained in Appendix B.

(2) The 19 aforementioned munition types were grouped into seven functional categories {Field Artillery, Aviation, Air Defense Artillery, Armor & Mechanized Infantry, Anti-Armor, Anti-Tank, and Infantry}. Each of the functional categories was divided into subcategories displayed in tables L-12, L-13, and L-14 for Corps, Division, and MEF maneuver units (respectively):

Table L-12: Key Functional Categories (Corps Units)

Category	Member Munition Type
Field Artillery	ATACMS - {ATACMS_I, ATACMS_IA, ATACMS_II/B, ATACMS_II/BP3I, ATACMS_IIA/BP3I} MLRS - {ER-MLRS, ER-MLRS/G, M26, M26IM, XRM26IM, XM85, XM85/G, TGW/MLRS, XRBAT/MLRS}
Aviation	HELLFIRE, LONGBOW, 2.75RKT, B30MM
Air Defense Artillery (ADA)	STINGER
Anti-Tank	LAW
Infantry	5.56MM, 7.62MM, 50CAL

Table L-13: Key Functional Categories (Division Units)

Category	Member Munition Type
Field Artillery	155MM - {M107 (CB), M116B1, M483A1, M549A1, M692/M731, M712, M718/M741, M864, XM898, XM982} ATACMS - {ATACMS_I, ATACMS_IA, ATACMS_II/B, ATACMS_II/BP3I, ATACMS_IIA/BP3I} MLRS - {ER-MLRS, ER-MLRS/G, M26}
Aviation	HELLFIRE, LONGBOW, 2.75RKT, B30MM
Air Defense Artillery (ADA)	STINGER
Armor & Mechanized Infantry	120MM - {120MM, M929, M933}
Anti-Armor	25MM
Anti-Tank	JAVELIN, LAW, TOWII
Infantry	5.56MM, 7.62MM, 40MM, 50CAL

Table L-14: Key Functional Categories (MEF Units)

Category	Member Munition Type
Field Artillery	155MM - {M107 (CB), M116B1, M121A1, M483A1, M549A1, M692/M731, M712, M718/M741, M864, XM898, XM982}
Aviation	B20MM
Air Defense Artillery (ADA)	STINGER
Armor & Mechanized Infantry	120MM - {120MM, PGMM, M929, M933} 81MM - {M821, M889, MERLIN/M252} 60MM - {M302A1, M720}
Infantry	5.56MM, 7.62MM, 40MM, 50CAL
Anti-Tank	JAVELIN, LAW, TOWII

(3) Tables L-15, L-16, and L-17 display the key munition types with the applicable aforementioned indices for each key munition at the end of the scenario. Tables L-15, L-16, and L-17 represent an aggregation by munition type for all units in the modeled force for the Corps, Division, and MEF (respectively).

- The first column, key munition type, lists each of the munition types included for analysis in this report.
- The second and third columns, amount authorized and BOH respectively, indicate quantities at initial state (TP 0) of the scenario.



- The fourth column, percentage of BOH of amount authorized, indicates that at initial state (TP 0) of the scenario, the quantity of munitions available for mission support was at least 100 percent and sufficient to meet requirements.  
(Except the Balance-on-Hand percentage of munition type ATACMS for the Corps and the Division maneuver units will trigger a "standard resupply replenishment" request. Also the Balance-on-Hand percentage of munition type 155MM for the MEF maneuver units will trigger a "standard resupply replenishment" request.
- The total amount used of a key munition type (column five) can exceed the End State BOH because during a particular TP a unit can receive and expend resupply.
- Munitions destroyed due to combat activity (column six) did not cause any significant inventory imbalances resulting in availability shortfalls.
- The seventh and eighth columns, amount authorized and BOH respectively, indicate quantities at end state (TP 7) of the scenario.
- The ninth column, percentage of Balance-on-Hand of amount authorized, indicates that at end state (TP 7) of the scenario, the quantity of munitions available for mission support was more than sufficient to meet requirements.

Table L-15: Key Munition Status (Corps Units)

Key Munition Type	Initial State			Utilization		End State		
	Amt Authorized {Rounds} @ TP 0	BOH @ TP 0 {Rounds}	Percentage BOH of Authorized	Total Amount Used {Rounds}	Total Amount Destroyed {Rounds}	Amt Authorized {Rounds} @ TP 7	BOH @ TP 7 {Rounds}	Percentage BOH of Authorized
ATACMS	2,400	1,260	52.5%	231	120	1,661	983	59.2%
MLRS	1,782	1,782	100%	36	10	1,589	1,736	109%
HELLFIRE	192	768	400%	0	0	132	768	581.8%
Longbow	192	768	400%	213	22	227	533	234.8%
2.75RKT	1,128	1,128	100%	0	0	777	1,128	145.2%
B30MM	28,800	28,800	100%	55	1,442	13,088	27,303	208.6%
STINGER	480	480	100%	0	0	331	480	145%
5.56MM	269,010	269,010	100%	0	0	267,269	269,010	100.7%
7.62MM	35,200	35,200	100%	0	0	34,664	35,200	101.5%
50CAL	2,940	2,940	100%	0	0	2,903	2,940	101.3%
LAW	55	55	100%	0	0	55	55	100%

- The 21<sup>st</sup> Corps Attack Helicopter Battalion had a Balance-on-Hand, which was four times the Amount Authorized for both the Hellfire and Longbow munition types at initial state (TP 0); the CSS system was able to support the Corps maneuver units at all times. For the MLRS, Longbow, and B30MM in the Corps, the BOH at end state was equal to the BOH at initial state minus the total amount used and destroyed throughout the scenario. (Reference table L-15).

Table L-16: Key Munition Status (Division Units)

Key Munition Type	Initial State			Utilization		End State		
	Amt Authorized {Rounds} @ TP 0	BOH @ TP 0 {Rounds}	Percentage BOH of Authorized	Total Amount Used {Rounds}	Total Amount Destroyed {Rounds}	Amt Authorized {Rounds} @ TP 7	BOH @ TP 7 {Rounds}	Percentage BOH of Authorized
155MM	15,930	15,930	100%	4,800	553	12,999	12,831	98.7%
ATACMS	1,800	900	50%	201	90	1,240	673	54.3%
MLRS	378	378	100%	0	5	260	373	143.4%
HELLFIRE	224	864	385.7%	50	2	139	812	584.2%
LONGBOW	192	768	400%	346	26	107	396	370.1%
2.75RKT	1,128	1,128	100%	0	0	629	1,128	179.3%
B30MM	28,800	28,800	100%	2,248	1,952	16,065	24,600	153.1%
STINGER	848	848	100%	3	7	617	862	139.7%
120MM	20,016	20,016	100%	1,273	752	11,268	18,821	167%
JAVELIN	390	390	100%	0	4	361	386	106.9%
LAW	155	155	100%	0	1	150	154	102.7%
25MM	245,700	245,700	100%	3,732	47,693	144,281	194,275	134.6%
40MM	34,320	34,320	100%	0	360	28,743	33,960	118.2%
5.56MM	2,788,590	2,788,590	100%	163,249	32,854	2,575,128	2,875,008	111.6%
7.62MM	400,400	400,400	100%	48,898	5,101	371,469	412,826	111.1%
50CAL	652,560	652,560	100%	11	23,249	550,034	629,300	114.4%
TOWII	1,911	1,911	100%	216	101	1,122	1,697	151.2%

- The 23<sup>rd</sup> Division had a Balance-on-Hand, which, was approximately four times the Amount Authorized for both the Hellfire and Longbow munition types at initial state (TP 0); the CSS system was able to support the Corps maneuver units at all times.
- For the MLRS, Hellfire, Longbow, B30MM, Javelin, Law, 25MM, 40MM, and 50CAL in the Division, the BOH at end state was equal to the BOH at initial state minus the total amount used and destroyed throughout the scenario. (Reference table L-16).
- The 23<sup>rd</sup> Division for the 155MM-munition type had a BOH of 15,930 rounds at initial state (TP 0). The BOH at end state was equal to the BOH at initial state minus the amount used and destroyed throughout the scenario plus 2,256 rounds received by truck. **However, the CSS system was able to support the Division maneuver units at all times.**
- The BOH for munition type 120MM in the 23<sup>rd</sup> Division at initial state was 20,016 rounds. The BOH at end state was equal to the BOH at initial state minus the amount used and destroyed throughout the scenario plus 830 rounds received by truck.
- The BOH at end state for munition type TOWII for the 23<sup>rd</sup> Division was equal to the BOH at initial state minus the amount used and destroyed throughout the scenario plus 104 rounds received by truck
- **NOTE: The BOH @ end state does not always equal the BOH @ initial state minus the total amount used and destroyed throughout the scenario.**

Table L-17: Key Munition Status (MEF Units)

Key Munition Type	Initial State			Utilization		End State		
	Amt Authorized {Rounds} @ TP 0	BOH @ TP 0 {Rounds}	Percentage BOH of Authorized	Total Amount Used {Rounds}	Total Amount Destroyed {Rounds}	Amt Authorized {Rounds} @ TP 7	BOH @ TP 7 {Rounds}	Percentage BOH of Authorized
155MM	1,320	1,320	100%	939	63	852	547	64.2%
120MM	2,320	2,320	100%	213	141	1,482	1,966	132.7%
60MM	5,700	5,700	100%	72	46	5,068	5,582	110%
81MM	5,904	5,904	100%	318	56	4,484	5,530	123.3%
B20MM	10,500	30,100	286.7%	369	1,492	14,601	28,239	193.4%
STINGER	272	272	100%	0	17	212	255	120.3%
5.56MM	1,642,650	1,642,650	100%	0	15,776	1,590,510	1,626,874	102.3%
7.62MM	236,400	236,400	100%	0	1,922	225,021	234,478	104.2%
50CAL	176,940	176,940	100%	3,865	10,487	153,505	162,588	105.9%
40MM	90,720	90,720	100%	35	3,462	75,262	87,223	115.9%
JAVELIN	414	414	100%	74	7	392	333	84.9%
LAW	100	100	100%	0	1	97	99	102.1%
TOWII	814	1,192	146.4%	287	25	712	880	123.6%

- The Balance-on-Hand percentage of munition type B20MM was higher than any other munition type for the MEF units.
- However, for the 120MM, 60MM, 81MM, B20MM, STINGER, 5.56MM, 7.62MM, 50CAL, 40MM, JAVELIN, LAW, and TOWII, the BOH at end state was equal to the BOH at initial state minus the total amount used and destroyed throughout the scenario. (Reference Table L-17).
- For the munition type 155MM in the MEF the BOH at end state was equal to the BOH at initial state minus amount used and destroyed throughout the scenario plus 229 rounds received by truck. Although the Balance-on-Hand percentage for the 155 munition type was less than 100, the MSSG was able to support the MEF maneuver units at all times.

(4) Tables L-18, L-19, and L-20 provide an overall summary of the resupply options, which helps assess the sufficiency of munition availability for the Corps, Division, and MEF maneuver units. These resupply options are shown by munition type; the individual indicators represent the presence (Yes) or absence (No) of that resupply option for a key munition type in the force at the end of a specific TP.

Table L-18: Balance-on-Hand Status (Corps Units)

Key Munition Type	No Resupply BOH ( $\geq 75\%$ )	Standard Resupply BOH (50%-74%)	Emergency Resupply BOH (0%-49%)	BOH (=0)
ATACMS	Yes	Yes	Yes	No
MLRS	Yes	No	No	No
HELLFIRE	Yes	No	No	No
Longbow	Yes	No	No	No
2.75RKT	Yes	No	No	No
B30MM	Yes	Yes	Yes	No
STINGER	Yes	No	No	No
LAW	Yes	No	No	No
5.56MM	Yes	No	No	No
7.62MM	Yes	No	No	No
50CAL	Yes	No	No	No

Table L-19: Balance-on-Hand Status (Division Units)

Key Munition Type	No Resupply BOH(>=75%)	Standard Resupply BOH(50%-74%)	Emergency Resupply BOH(0%-49%)	BOH(=0)
155MM	Yes	Yes	Yes	Yes
ATACMS	Yes	Yes	Yes	No
MLRS	Yes	No	No	No
HELLFIRE	Yes	No	No	No
LONGBOW	Yes	No	No	No
2.75RKT	Yes	No	No	No
B30MM	Yes	Yes	Yes	No
STINGER	Yes	Yes	Yes	No
120MM	Yes	Yes	No	No
25MM	Yes	Yes	No	No
JAVELIN	Yes	No	No	No
LAW	Yes	No	No	No
TOWII	Yes	Yes	Yes	Yes
5.56MM	Yes	No	Yes	No
7.62MM	Yes	No	Yes	No
40MM	Yes	No	No	No
50CAL	Yes	No	No	No

Table L-20: Balance-on-Hand Status (MEF Units)

Key Munition Type	No Resupply BOH(>=75%)	Standard Resupply BOH(50%-74%)	Emergency Resupply BOH(0%-49%)	BOH(=0)
155MM	Yes	Yes	Yes	Yes
B20MM	Yes	No	No	No
STINGER	Yes	No	No	No
120MM	Yes	No	No	No
81MM	Yes	No	No	No
60MM	Yes	No	No	No
40MM	Yes	No	No	No
7.62MM	Yes	No	No	No
5.56MM	Yes	No	No	No
50CAL	Yes	No	No	No
JAVELIN	Yes	No	Yes	Yes
LAW	Yes	No	No	No
TOWII	Yes	Yes	Yes	Yes

- None of the munition types experience a zero Balance-on-Hand for the Corps maneuver units. Two of the munition types (155MM and TOWII) experience a zero Balance-on-Hand for the Division maneuver units. Three of the munition types (155MM, JAVELIN, and TOWII) experience a zero Balance-on-Hand for the MEF maneuver units. Tables L-21 through L-25 depict specific units, time periods, and sub-munition types, which experience a zero Balance-on-Hand.

Table L-21: 155MM Zero Balance (Division Units)

Unit Name	BOH(=0)	Time Period(TP)	Sub-munition
B201A2: FA HIP Bty	0	TP 5,6,7	M483A1
	0	TP 7	M549A1
	0	TP 4,5,6,7	M864
B202A2: FA HIP Bty	0	TP 7	M549A1
	0	TP 4,5,6,7	M864
B203A2: FA HIP Bty	0	TP 7	M549A1
	0	TP 4,5,6,7	M864
B204A2: FA HIP Bty	0	TP 7	M864
B205A2: FA HIP Bty	0	TP 7	M864
B206A2: FA HIP Bty	0	TP 7	M864
B207A2: FA HIP Bty	0	TP 7	M549A1
	0	TP 5,6,7	M864
B208A2: FA HIP Bty	0	TP 5,6,7	M864
B209A2: FA HIP Bty	0	TP 5,6,7	M864

Table L-22: TOWII Zero Balance (Division Units)

Unit Name	BOH(=0)	Time Period(TP)	Sub-munition
B200DC: Div Cav Sqdn	0	TP 4 & 5	TOWII

Table L-23: 155MM Zero Balance (MEF Units)

Unit Name	BOH(=0)	Time Period(TP)	Sub-munition
B51AT2: Arty Bty	0	TP 7	M107/CB
	0	TP 7	M483A1
	0	TP 6 & 7	M549A1
	0	TP 6 & 7	M864
B51BT2: Arty Bty	0	TP 7	M107/CB
	0	TP 7	M483A1
	0	TP 6 & 7	M549A1
	0	TP 6 & 7	M864
B51CT2: Arty Bty	0	TP 7	M107/CB
	0	TP 7	M483A1
	0	TP 6 & 7	M549A1
	0	TP 6 & 7	M864

Table L-24: JAVELIN Zero Balance (MEF Units)

Unit Name	BOH(=0)	Time Period(TP)	Sub-munition
B521IN: 1 <sup>st</sup> Inf Bn MEF RLT	0	TP 7	JAVELIN

Table L-25: TOWII Zero Balance (MEF Units)

Unit Name	BOH(=0)	Time Period(TP)	Sub-munition
B513IN: 3 <sup>rd</sup> Inf Bn MEF Landing Bde	0	TP 7	TOWII
B514AR: 4 <sup>th</sup> Armor Bn MEF Landing Bde	0	TP 7	TOWII
B521IN: 1 <sup>st</sup> Inf Bn MEF RLT	0	TP 7	TOWII

(c) Problems. Of the 2716 stons ordered (for Corps, Division, and MEF maneuver units), 489 stons were shipped (18 percent). Problems in unfilled orders are due to either unavailable trucks or supplies (Tables L-26 and L-27). **There were no problems in filling Class V orders for MEF maneuver units.**

Table L-26: Problems Filling Maneuver Unit Orders, Class V (Corps Units)

TP	REQUESTING UNIT	SUPPLY UNIT	SUPPLY TYPE	AMOUNT REQUESTED (Rounds)	AMOUNT SHIPPED (Rounds)	AMOUNT SHORTED (%)	TRUCKS AVAIL	AVAIL STOCKS (Rounds)
1	B000M2	B00M2F	ATACMS I	179	14	92.2%	4	0
2	B001M2	B00M2F	ATACMS II/	29	3	89.6%	0	6
4	B001M2	B00M2F	ATACMS II/	35	5	85.7%	5	0
6	B001M2	B00M2F	ER-MLRS/G	132	31	76.5%	6	0
	TOTAL			375	53	85.8%		

Table L-27 Problems Filling Maneuver Unit Orders, Class V (Division Units)

TP	REQUESTING UNIT	SUPPLY UNIT	SUPPLY TYPE	AMOUNT REQUESTED (Rounds)	AMOUNT SHIPPED (Rounds)	AMOUNT SHORTED (%)	TRUCKS AVAIL	AVAIL STOCKS (Rounds)
1	B220EN	B22BSA	BWAMM	21,240	720	96.6%	12	0
1	B220EN	B22BSA	5.56MM	57,540	31,685	44.9%	149	0
1	B230EN	B23BSA	BWAMM	21,264	720	96.6%	12	0
1	B210EN	B21BSA	BWAMM	21,231	720	96.6%	12	0
1	B210EN	B21BSA	5.56MM	57,540	32,352	43.8%	149	0
1	B200M2	B20M2F	ATACMS I	179	14	92.2%	6	0
1	B200M2	B23BSA	ATACMS I	179	2	98.9%	0	44
1	B200M2	B23BSA	ATACMS I	163	0	100%	0	44
1	B200M2	B23BSA	ATACMS I	163	0	100%	0	44
3	B200M2	B23BSA	ATACMS I	64	14	78.1%	0	29
4	B230EN	B23BSA	BWAMM	10,907	15	99.8%	0	16
4	B200M2	B23BSA	ATACMS I	55	4	92.7%	0	10
4	B200M2	B20M2F	ATACMS II/	81	10	87.6%	0	25
5	B202A2	B21A2F	XM898	236	28	88.1%	4	0
5	B202A2	B21BSA	XM898	236	28	88.1%	4	0
5	B230EN	B23BSA	BWAMM	11,037	15	99.8%	12	0
6	B200M2	B23BSA	ATACMS I	96	9	90.6%	24	0
6	B200M2	B20M2F	ATACMS II/	111	0	100%	0	24
6	B213MX	B21BSA	M933	147	84	42.8%	5	0
6	B201A2	B21BSA	M483A1	197	103	47.7%	0	995
7	B200M2	B20M2F	ER-MLRS/G	28	11	60.7%	0	33
7	B230EN	B23BSA	BWAMM	9,422	10	99.9%	12	0
	TOTAL			212,116	66,544	68.6%		

- In table L-28, supply type-maneuver unit combinations that have a zero BOH are presented. The table has been coded: 0 - time and distance problems; 1 - unsupported materiel; 2 - insufficient replenishment stockages; and 3 - unavailable transporters. Generally, once a unit experiences a zero BOH, the zero BOH continues to the end of the scenario.
- Zero BOH for Corps, Division, and MEF maneuver units are attributed to shortages of transporters, shortages of Class V supply replenishments, and large time-distances between maneuver units and their supporting CSS unit (reference Table L-28). The reader is cautioned regarding the "0"; some artillery consume everything on-hand, and cannot be provided a supply type fast enough regardless of the speed of the CSS system.

Table L-28: Causes for Zero BOH

MANEUVER UNIT	SUPPLY TYPE	TP								
		0	1	2	3	4	5	6	7	# TPs
B000M2	ER-MLRS								0	1
B000M2	ER-MLRS/G					0		0	0	3
B200M2	ER-MLRS/G					0	0	0	0,3	4
B201A2	M483A1						0	0	0	3
B201A2	M549A1								0	1
B201A2	M864					0	0	0	0	4
B201DC	M933				0	0				2
B202A2	M549A1								0	1
B202A2	M864					0	0	0	0	4
B202DC	M933				0	0				2
B203A2	M549A1								0	1
B203A2	M864					0	0	0	0	4
B203DC	M933					0	0		0	3
B203DC	TOWII					0	0			2
B204A2	M864								0	1
B205A2	M864								0	1
B206A2	M864								0	1
B207A2	M549A1								0	1
B207A2	M864						0	0	0	3
B208A2	M864						0	0	0	3
B209A2	M864						0	0	0	3
B213MX	M933								0,2	1
B513IN	TOWII								0	1
B514AR	TOWII								0	1
B51AT2	M107/CB								0	1
B51AT2	M483A1								0	1
B51AT2	M549A1							0	0	2
B51AT2	M864							0	0	2
B51BT2	M107/CB								0	1
B51BT2	M483A1								0	1
B51BT2	M549A1							0	0	2
B51BT2	M864							0	0	2
B51CT2	M107/CB								0	1
B51CT2	M483A1								0	1
B51CT2	M549A1							0	0	2
B51CT2	M864							0	0	2
B521IN	JAVELIN								0	1
B521IN	TOWII								0	1
Total		0	0	0	2	9	10	15	35	71

(d) Observations.

(1) **Two** of the munition types (**155MM** and **TOWII**) experience a **zero Balance-on-Hand** for the **Division** maneuver units. **Three** of the munition types (**155MM, JAVELIN, and TOWII**) experience a **zero Balance-on-Hand** for the **MEF** maneuver units. **None** of the munition types experience a zero Balance-on-Hand for the **Corps** maneuver units.

(2) **Problems** with supply **Class V unfilled orders** for the **Corps** and the **Division** maneuver units are primarily associated with time and distance. There were **no problems** in filling Class V orders for **MEF** maneuver units.



# APPENDIX A

VIC Name to Unit Name Cross Reference	
VIC Name	Unit Name
B00000	21 <sup>ST</sup> CORPS
B000AH	21 <sup>ST</sup> CORPS ATK HEL BN (AH64)
B00AHF	21 <sup>ST</sup> CORPS ATK HEL FLE
B01CSA	21 <sup>ST</sup> CORPS SPT GROUP
B001M2	21 <sup>ST</sup> CORPS HIMARS BTY
B000M2	21 <sup>ST</sup> CORPS MLRS BTY
B00M2F	21 <sup>ST</sup> CORPS MLRS FLE
B200MX	23 <sup>RD</sup> DIVISION
B210AR	1/23 <sup>RD</sup>
B211AR	1-1 AR TF
B212AR	2-1 AR TF
B213MX	3-1 MECH TF
B211S1	ADA AVENGER BTRY
B212S1	ADA AVENGER BTRY
B213P1	ADA AVENGER BTRY
B210EN	ENGINEER BN
B21BSA	FOWARD SPT BN
B21FLE	FOWARD SPT BN
B220AR	2/23 <sup>RD</sup>
B221AR	1-2 AR TF
B222AR	2-2 AR TF
B223MX	3-2 MECH TF
B224MX	4-2 MECH TF
B221S1	ADA AVENGER BTRY
B222S1	ADA AVENGER BTRY
B223P1	ADA AVENGER BTRY
B220EN	ENGINEER BN
B22BSA	FOWARD SPT BN
B22FLE	FOWARD SPT BN
B230AR	3/23 <sup>RD</sup>
B231AR	1-3 AR TF
B232AR	2-3 AR TF
B233MX	3-3 MECH TF
B231S1	ADA AVENGER BTRY
B232S1	ADA AVENGER BTRY
B233P1	ADA AVENGER BTRY
B230EN	ENGINEER BN
B23BSA	FOWARD SPT BN
B23FLE	FOWARD SPT BN
B20002	DIV ARTY BDE
B201A2	FA HIP BTY
B21A2F	FA FLE
B202A2	FA HIP BTY
B203A2	FA HIP BTY
B204A2	FA HIP BTY
B24A2F	FA FLE
B205A2	FA HIP BTY
B206A2	FA HIP BTY
B207A2	FA HIP BTY
B27A2F	FA FLE
B208A2	FA HIP BTY
B209A2	FA HIP BTY
B200M2	MLRS BTRY
B20M2F	DIV MLRS FLE
B201AH	AH64 BN

VIC Name to Unit Name Cross Reference	
VIC Name	Unit Name
B21AHF	AH64 FLE
B200DC	DIV CAV SQDN
B20DCF	CAV FLE
B201DC	CAV TRP
B202DC	CAV TRP
B203DC	CAV TRP
B200SH	AIR CAV TRP
B20SHF	AIR CAV FLE
B20DSA	MAIN SPT BN
B30000	1 <sup>ST</sup> KUWAIT DIVISION
B30DSA	1 <sup>ST</sup> KUWAIT DIV SPT BDE
B300AH	AH64 BN
B30001	ADA BDE
B31AH1	ADA MISSILE PLT
B31BH1	ADA MISSILE
B31CH1	ADA MISSILE
B31DH1	ADA MISSILE
B31EH1	ADA MISSILE
B31FH1	ADA MISSILE
B31GH1	ADA MISSILE
B31HH1	ADA MISSILE
B31IH1	ADA MISSILE
B32AH1	ADA MISSILE PLT
B32BH1	ADA MISSILE
B32CH1	ADA MISSILE
B32DH1	ADA MISSILE
B32EH1	ADA MISSILE
B32FH1	ADA MISSILE
B32GH1	ADA MISSILE
B32HH1	ADA MISSILE
B32IH1	ADA MISSILE
B33AH1	KUWAITI PATRIOT MISSILE BTY
B33BH1	ADA MISSILE
B33CH1	ADA MISSILE
B33DH1	ADA MISSILE
B33EH1	ADA MISSILE
B33FH1	ADA MISSILE
B33GH1	SAUDI PATRIOT MISSILE BTY
B33HH1	ADA MISSILE
B33IH1	ADA MISSILE
B33JH1	ADA MISSILE
B33KH1	ADA MISSILE
B33LH1	ADA MISSILE
B33MH1	ADA MISSILE
B33NH1	ADA MISSILE
B33OH1	ADA MISSILE
B33PH1	ADA MISSILE
B33QH1	US PATRIOT MISSILE BTY
B33RH1	ADA MISSILE
B33SH1	ADA MISSILE
B33TH1	ADA MISSILE
B33UH1	ADA MISSILE
B33VH1	ADA MISSILE
B33WH1	ADA MISSILE
B33XH1	ADA MISSILE
B33YH1	ADA MISSILE
B33ZH1	ADA MISSILE

VIC Name to Unit Name Cross Reference	
VIC Name	Unit Name
B34AH1	ADA MISSILE PLT
B34BH1	ADA MISSILE
B34CH1	ADA MISSILE
B34DH1	ADA MISSILE
B34EH1	ADA MISSILE
B34FH1	ADA MISSILE
B34GH1	ADA MISSILE
B34HH1	ADA MISSILE
B34IH1	ADA MISSILE
B35AH1	ADA MISSILE PLT
B35BH1	ADA MISSILE
B35CH1	ADA MISSILE
B35DH1	ADA MISSILE
B35EH1	ADA MISSILE
B35FH1	ADA MISSILE
B35GH1	ADA MISSILE
B35HH1	ADA MISSILE
B35IH1	ADA MISSILE
B36AH1	ADA MISSILE PLT
B36BH1	ADA MISSILE
B36CH1	ADA MISSILE
B36DH1	ADA MISSILE
B36EH1	ADA MISSILE
B36FH1	ADA MISSILE
B36GH1	ADA MISSILE
B36HH1	ADA MISSILE
B36IH1	ADA MISSILE
B30002	ARTY BDE
B30BSA	FORWARD SPT BN
B30AM2	300 MM BTY
B30BM2	300 MM BTY
B30CM2	300 MM BTY
B30AA2	155 MM SP BTY
B30BA2	155 MM SP
B30CA2	155 MM SP
B30DA2	155 MM SP
B30EA2	155 MM SP
B30FA2	155 MM SP
B30GA2	155 MM SP
B30HA2	155 MM SP
B30IA2	155 MM SP
B30JA2	155 MM SP
B30KA2	155 MM SP
B30LA2	155 MM SP
B30006	COMMANDO BN
B37000	NATIONAL GUARD BDE
B37BSA	FORWARD SPT BN
B371MX	NATIONAL GUARD MECH BN
B372IN	NATIONAL GUARD INF BN
B373IN	NATIONAL GUARD INF BN
B374IN	NATIONAL GUARD INF BN
B375SF	NATIONAL GUARD SF BN
B310AR	15 <sup>TH</sup> ARMOR BDE
B311AR	ARMOR BN
B312AR	ARMOR BN
B313AR	ARMOR BN
B314MX	MECH BN

VIC Name to Unit Name Cross Reference	
VIC Name	Unit Name
B320AR	26 <sup>TH</sup> ARMOR BDE
B321AR	ARMOR BN
B322AR	ARMOR BN
B323MX	MECH BN
B330AR	35 <sup>TH</sup> ARMOR BDE
B331AR	ARMOR BN
B332AR	ARMOR BN
B333MX	MECH BN
B340MX	6 <sup>TH</sup> MECH BDE
B341AR	ARMOR BN
B342MX	MECH BN
B343MX	MECH BN
B344MX	MECH BN
B350MX	RESERVE MECH BDE
B351MX	MECH BN
B352MX	MECH BN
B353MX	MECH BN
B354MX	MECH BN
B31BSA	LOG BN
B32BSA	LOG BN
B33BSA	LOG BN
B34BSA	LOG BN
B35BSA	LOG BN
B50000	MEF
B500AH	MEF ATK HELO
B50AHF	MEF ATK HELO FLE
B501CH	LIFT HELO BN
B51CHF	LIFT HELO FLE
B510MX	MEF LANDING BDE
B511MX	BN TASK FORCE
B512MX	BN TASK FORCE
B513IN	INF BN
B514AR	ARMOR BN
B51AT2	ARTY BTY
B51BT2	ARTY BTY
B51CT2	ARTY BTY
B510P1	ADA AVENGER BTRY
B511RE	RECON TRP
B512RE	RECON TRP
B513RE	RECON TRP
B511EN	ENGINEER BN
B51SSD	SERVICE SPT
B520MX	MEF RLT
B521IN	INF BN
B522IN	INF BN
B523IN	INF BN
B52SSD	SERVICE SPT
B50SSA	MEF SERVICE SPT
B60000	US NAVY ASSETS
B70000	SAUDI UNITS
B71BSA	FORWARD SPT BN
B710MX	PSB 20 <sup>TH</sup> MECH BDE
B711A2	155 MM SP BN
B711M2	MRL ASTROS BN
B711RE	RECON CO
B711MX	MECH BN
B712MX	MECH BN

VIC Name to Unit Name Cross Reference	
VIC Name	Unit Name
B713MX	MECH BN
B714AR	ARMOR BN
B715MX	MECH BN (57 <sup>TH</sup> KUWAITI)
B720AR	6 <sup>TH</sup> ARMOR BDE
B721AH	AH64 BN
B722AH	AH64 BN
B721A2	155 MM SP BN
B721RE	RECON CO
B721AR	MECH BN
B722AR	MECH BN
B723AR	MECH BN
B724MX	ARMOR BN
B730MR	2 <sup>ND</sup> SANG BDE
B731A2	155 MM SP BN
B731MR	5 <sup>TH</sup> MOTORIZED BN
B732MR	6 <sup>TH</sup> MOTORIZED BN
B733MR	7 <sup>TH</sup> MOTORIZED BN
B734MR	8 MOTORIZED BN

## APPENDIX B

### DEFINITIONS

Specific supply analysis definitions are listed below:

(1) Amount Authorized of this supply type: Amount of this supply type that this unit is authorized at the end of the TP, this number is calculated by multiplying the number of available systems that use this supply type by the amount authorized per system. This number can change from one TP to another due to weapon losses.

(2) Balance-on-Hand of this supply type: Amount of this supply type that this unit has on hand at the end of the TP.

(3) Amount Used during this TP: Amount of this supply type that this unit used during this TP.

(4) Amount Destroyed during this TP: Amount of this supply type that was destroyed due to attrition of systems (when a system is assumed destroyed in combat a percentage (50) of its on-board supplies are assumed destroyed).

(5) Ratio of Balance on-Hand to Amount Authorized: A percent value used to indicate overall assessment of a munition; when this percent value is low, a greater risk is indicated as to possibility of exhausting all supplies.

(6) Total Amount Authorized during this TP: The sum of each amount authorized of each supply type at the end of the TP. The stockages are redistributed, used, or destroyed as the scenario proceeds. As units are engaged and attrited, the amount-authorized is reconciled with the number of surviving weapon systems.

(7) Total Amount-on-Hand during this TP: The sum of the amount of each supply type that the units actually have in stock at the end of the TP. Utilization, attrition, and other activities that may reduce the stockage of a supply type reduce this amount.

(8) Total Amount Used during this TP: The sum of the amount of each supply type consumed as a result of movement and combat at the end of the TP.

(9) Total Amount Destroyed during this TP: The sum of the amount of each supply type destroyed due to attrition of systems at the end of the TP (when a system is damaged in combat, a percentage of its on-board supplies are destroyed).

(10) Total Amount-on-Order during this TP: The sum of the amounts of each supply type ordered by each unit during a period. As materiel is consumed, units initiate orders based on a re-order threshold to restock its supplies. If an order cannot be shipped for reasons of shortages of stocks or movers, a unit will re-order the replenishments during the next period.

(11) Timely Fashion: When a maneuver unit calls for replenishment of supplies, the support of the maneuver unit shall be said to be in a

"timely fashion," if the maneuver unit did not suffer for lack of supplies. For class IIIB, a unit suffers when it is forced to stop for lack of class IIIB. For class V, a unit suffers a negative consequence when it exhausts a class V supply type.

(12) Standard Resupply: Maneuver units will generate an order for a supply type when, per the resupply schedule, the on-hand plus on-order quantity is less than 75 percent of the authorized quantity. The magnitude of the order is the amount of each supply type to bring the on-hand plus on-order quantity up to the authorized quantity. Routinely, the order is for 25 percent of authorized. When the shipment arrives, the on-hand balance will increase, and the maneuver unit will issue an order when the on-hand quantity again falls below the 75 percent authorized. Exceptions to this resupply process occur when, for lack of trucks or stocks, an order cannot be filled or shipped. When the order (or portion of it) cannot be shipped in the period it was requested, the unfilled portion is discarded - there are no backorders or due-outs. The maneuver unit will reassess its needs during the next period. Standard resupply can be divided into two types: supply point distribution (SPD) and unit distribution (UD). A unit that uses SPD provides its own organic transporters to convey replenishments between the supply unit(s) and itself; a unit using UD requires the supply unit to provide both replenishments and transporters.

(13) Emergency Resupply: Maneuver units will generate an "emergency" order for a supply type when, per the resupply schedule, the on-hand plus on-order quantity is less than 50 percent of the authorized quantity. The magnitude of the order is the amount of each supply type to bring the on-hand quantity up to 50 percent of the authorized quantity. When the shipment arrives, the on-hand balance will increase. This is "emergency resupply." Emergency resupply is subject to a number of factors: (1) the availability of replenishment stockages; (2) the availability of helicopter support to provide airlift between the supporting CSS unit(s) and the requesting maneuver unit; and (3) the hostile environment surrounding the maneuver unit. If the scenario is short-lived or has intensive combat, the last factor can be the most limiting. Helicopters will not provide lift to maneuver units that are under assault. If any one of the factors prohibits emergency resupply, the "emergency" request for replenishments will be routed for "standard" resupply. When the order (or portion of same) cannot be shipped in the time period it was requested, the unfilled portion is discarded - there are no backorders or due-outs - the unit must wait for the next period per the resupply schedule to assess its stockage position and re-order.

## GIST

**STUDY TITLE:** Combat Service Support (CSS) Vector-in-Commander (VIC) Analysis in Support of Southwest Asia Corps/Division Scenario 7.0 (SWA CDS 7.0) Excursion – CSS Analysis of VIC Dynamic Gaming Army of Excellence (AOE) Heavy Division Design.

**PURPOSE:** The purpose of this analysis was to produce a quantitative analysis of an aviation excursion of the Army of Excellence Heavy Division Design's combat service support (CSS) structure which was dynamically gamed in the Southwest Asia scenario with the VIC model. The focus of the analysis was on the maintenance and supply operations and how the CSS units functioned for the given scenario.

**MAIN ASSUMPTIONS:** The principal assumptions of this study include: (a) all repair parts were available upon request, (b) Echelons-Above-Division (EAD) were fully resourced, and (c) Recovery assets will never impede helicopter return to combat.

**PRINCIPAL FINDINGS:** No CSS support services hindered the availability of any weapon systems for the AOE Heavy Division during the 30-hour battle in the SWA CDS 7.0 scenario excursion with a couple of exceptions. There were minor delays with respect to recovery vehicles and repair teams, but these delays were too inconsequential to consider them shortfalls in the CSS system. The M88 recovery operations for two recovery teams could not handle the workload produced during this scenario excursion due to the lack of the initial quantity of M88s given to these maneuver units. The corps was hampered from evacuating the necessary vehicles and weapon systems to the corps supply area (CSA) due to time-distance factors and the magnitude of the workload produced by the scenario. Also there was an insufficient quantity of host nation support (HNS) ambulances available to evacuate injured personnel to the CSA. A few artillery units expended all of their ammunition resources at some time during the scenario and could not be resupplied in a timely manner due to either a shortage of trucks or nonavailability of stocks for replenishment.

**IMPACT:** This report suggests that the CSS structure in the AOE Heavy Division is sufficient to sustain the division in an aviation excursion of a scenario such as the one portrayed in SWA CDS 7.0 excursion.

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**DTIC:**



## SECURITY CHECKLIST

1. TITLE OF STUDY: Combat Service Support (CSS) Vector-in-Commander (VIC) Analysis in Support of Southwest Asia Corps/Division Scenario 7.0 (SWA CDS 7.0) Excursion – CSS Analysis of VIC Dynamic Gaming Army of Excellence (AOE) Heavy Division Design Technical Report.

2. CLASSIFICATION ASSIGNED (CHECK ONE)

☐ TS      ☐ SECRET      ☐ CONFIDENTIAL      ☒ UNCLASSIFIED

A. ☐ ORIGINAL CLASSIFICATION. IF XGDS, IDENTIFY APPROVING TOP SECRET AUTHORITY

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(1) \_\_\_\_\_

(2) \_\_\_\_\_

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D. ☐ BASIS FOR DOWNGRADING/DECLASSIFICATION INSTRUCTIONS INDICATED IN PARA 2C ABOVE.

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C. INFORMATION ORIGINATED BY AGENCIES OUTSIDE OF DOD. NO

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## APPENDIX C

Reference (b).1). of Section (2), Key Weapon Availability -- end % availability is the weapon system's availability at the end of the scenario. This availability calculation excludes permanent losses in conformance with the earlier described sufficiency criteria. Permanent losses are excluded because their occurrence is independent of how well (or poorly) CSS performs. Note: Because of rounded off values, the ending percent availability may be off by a percentage point or two.

Table C-1: M1A1 Status (USARMY and MEF)

Unit ID	Initial Str	End Str	K-Kills	End % Avail	AVG	LOW	HIGH
B211AR	44	21	10	61	32	20	41
B212AR	44	31	11	93	27	11	40
B213MX	28	18	3	71	20	18	22
B221AR	44	42	0	95	41	40	42
B222AR	30	29	0	95	28	28	29
B223MX	28	27	0	95	26	26	27
B224MX	14	13	0	91	13	13	13
B231AR	44	5	12	17	32	5	42
B232AR	44	36	2	86	36	24	42
B233MX	28	15	1	55	25	15	27
B511MX	14	8	1	58	12	8	13
B514AR	44	19	6	50	38	19	42
Total Permanent Losses			46				

Table C-2: M1A2 Status (USARMY)

Unit ID	Initial Str	End Str	K-Kills	End % Avail	AVG	LOW	HIGH
B201DC	9	6	0	71	7	6	9
B202DC	9	9	0	100	9	8	9
B203DC	9	6	1	73	7	6	9
Total Permanent Losses			1				

Table C-3: IFV/TOW Status (USARMY)

Unit ID	Initial Str	End Str	K-Kills	End % Avail	AVG	LOW	HIGH
B200DC	2	2	0	100	2	2	2
B201DC	13	9	1	76	11	9	13
B202DC	13	13	2	121	11	9	13
B203DC	13	0	5	0	5	0	13
B211AR	14	5	4	48	10	5	12
B212AR	14	6	5	67	6	0	11
B213MX	30	0	11	0	12	0	22
B221AR	14	14	0	97	14	13	14
B222AR	28	27	0	97	27	27	27
B223MX	30	29	0	97	29	29	29
B224MX	44	41	0	95	42	41	43
B231AR	14	4	4	39	11	4	14
B232AR	14	10	1	76	12	10	14
B233MX	30	17	2	63	27	17	29
Total Permanent Losses			35				

Table C-4: BSFV Status (USARMY)

Unit ID	Initial Str	End Str	K-Kills	End % Avail	AVG	LOW	HIGH
B211S1	4	4	0	99	4	4	4
B212S1	4	4	0	92	4	4	4
B221S1	4	4	0	99	4	4	4
B222S1	4	4	0	99	4	4	4
B231S1	4	4	0	99	4	4	4
B232S1	4	4	0	98	4	4	4
Total Permanent Losses			0				

Table C-5: LAV/TOW Status (MEF)

Unit ID	Initial Str	End Str	K-Kills	End % Avail	AVG	LOW	HIGH
B511RE	7	7	0	99	7	7	7
B512RE	7	7	0	99	7	7	7
B513RE	7	7	0	98	7	7	7
Total Permanent Losses			0				

Table C-6: AAV/MK19 Status (MEF)

Unit ID	Initial Str	End Str	K-Kills	End % Avail	AVG	LOW	HIGH
B511MX	35	24	4	78	33	24	35
B512MX	45	37	3	88	43	37	44
B514AR	10	7	1	75	9	7	10
Total Permanent Losses			8				

Table C-7: AVENGER Status (USARMY and MEF)

Unit ID	Initial Str	End Str	K-Kills	End % Avail	AVG	LOW	HIGH
B213P1	6	5	0	97	5	5	6
B223P1	6	6	0	99	6	6	6
B233P1	6	6	0	99	6	5	6
B510P1	6	6	0	100	6	6	6
B511MX	4	2	1	66	4	2	4
B512MX	4	2	1	69	4	2	4
B513IN	4	1	1	23	3	1	4
B514AR	4	1	1	37	4	1	4
B521IN	4	1	1	33	4	1	4
B522IN	4	4	0	96	4	4	4
B523IN	4	2	0	69	4	2	4
Total Permanent Losses			5				

Table C-8: MLRS Status (USARMY)

Unit ID	Initial Str	End Str	K-Kills	End % Avail	AVG	LOW	HIGH
B000M2	9	6	2	87	5	3	9
B200M2	9	6	2	89	6	4	9
Total Permanent Losses			4				

Table C-9: HIMARS Status (USARMY)

Unit ID	Initial Str	End Str	K-Kills	End % Avail	AVG	LOW	HIGH
B001M2	3	3	0	100	3	2	3
Total Permanent Losses			0				

Table C-10: 155HIP Status (USARMY)

Unit ID	Initial Str	End Str	K-Kills	End % Avail	AVG	LOW	HIGH
B201A2	6	2	3	76	4	2	5
B202A2	6	5	1	96	5	4	5
B203A2	6	6	0	93	6	6	6
B204A2	6	6	0	93	6	6	6
B205A2	6	6	0	93	6	6	6
B206A2	6	6	0	93	6	6	6
B207A2	6	2	3	57	5	2	6
B208A2	6	6	0	93	6	6	6
B209A2	6	6	0	93	6	6	6
Total Permanent Losses			7				

Table C-11: OH58D Status (USARMY)

Unit ID	Initial Str	End Str	K-Kills	End % Avail	AVG	LOW	HIGH
B200SH	16	11	0	70	14	11	16
Total Permanent Losses			0				

Table C-12: AH64D Status (USARMY)

Unit ID	Initial Str	End Str	K-Kills	End % Avail	AVG	LOW	HIGH
B000AH	24	20	2	93	19	14	21
B201AH	24	20	3	94	18	15	21
Total Permanent Losses			5				

Table C-13: AH-1 Status (USARMY)

Unit ID	Initial Str	End Str	K-Kills	End % Avail	AVG	LOW	HIGH
B500AH	14	8	4	85	13	8	14
Total Permanent Losses			4				

# APPENDIX D

Table D-1: **Kuwaiti** Units Rendered Combat Ineffective During the Scenario

Ineffective "Dead" Unit	Time	Major Weapon Systems
B35EH1	7.1	ASPIDE
B32FH1	7.1	IHAWK
B35FH1	7.2	ASPIDE
B32DH1	7.5	IHAWK
B32EH1	7.5	IHAWK
B35AH1	7.5	ASPIDE
B33BH1	8.0	PATRIOT
B33FH1	8.6	PATRIOT
B31GH1	8.9	STARBURST
B35DH1	8.9	ASPIDE
B32CH1	8.9	IHAWK
B32AH1	9.6	IHAWK
B32BH1	10.5	IHAWK
B342MX	11.7	KBMP
B33CH1	15.3	PATRIOT
B34AH1	21.8	ASPIDE
B34BH1	21.8	ASPIDE
B34CH1	21.8	ASPIDE

Table D-2: **Saudi** Units Rendered Combat Ineffective During the Scenario

Ineffective "Dead" Unit	Time	Major Weapon Systems
B714AR	6.3	M60A3
B711MX	6.3	M113/TOW
B711A2	6.9	155HIP
B713MX	7.2	M113/TOW
B711RE	7.3	M113/TOW, M60A3
B715MX	7.5	IFV/TOW
B732MR	12.5	LAV/90MM, LAV/TOW
B734MR	13.0	LAV/90MM, LAV/TOW
B731A2	14.0	155HIP
B733MR	18.1	LAV/90MM, LAV/TOW
B731MR	21.1	LAV/90MM, LAV/TOW

# APPENDIX E

## FIGURES AND TABLES

Table E-1: Truckloads On-Road, CSS-to-Maneuver Units (Corps Units)

CLASS IIIB & V, TRUCKLOADS BY TP						
TP	ATACMS I	ATACMS II/B	B30MM	ER-MLRS	ER-MLRS/G	TOTAL
1	1.75	---	---	---	---	1.75
2	---	3.66	---	---	---	3.66
3	---	3.20	0.87	---	---	4.07
4	---	3.91	0.87	---	0.82	5.60
5	---	---	0.87	---	1.12	1.99
6	---	---	0.87	0.40	1.13	2.40
7	---	---	---	---	1.43	1.43

Table E-2: Truckloads On-Road, CSS-to-Maneuver Units (Division Units)

CLASS IIIB & V, TRUCKLOADS BY TP											
TP	7.62MM	5.56MM	ATACMS I	ATACMS II/B	M483A1	M549A1	M864	M933	POL-B	POL-BACFT	TOTAL
1	0.15	0.3	2.0	---	---	---	---	---	10.08	---	12.66
2	---	---	2.0	---	---	---	---	---	3.49	---	17.81
3	---	---	1.82	---	---	---	---	0.16	11.67	---	22.18
4	---	---	2.33	1.31	---	0.49	0.15	0.68	4.66	---	12.06
5	---	---	0.51	1.31	0.57	0.82	1.13	0.52	---	---	10.97
6	---	---	1.21	0.03	0.97	0.73	1.77	0.30	---	0.63	5.84
7	---	---	1.21	0.03	0.68	2.24	2.43	0.38	---	0.63	7.3

Table E-3: Truckloads On-Road, CSS-to-Maneuver Units (Division Units)

CLASS IIIB & V, TRUCKLOADS BY TP											
TP	B30MM	ER-MLRS	ER-MLRS/G	XM898	XM982	TOWII	M107/CB	M929	BWAMM	STING	TOTAL
1	1.23	---	---	---	---	---	---	---	7.71	---	9.1
2	1.23	---	---	---	---	---	---	---	---	0.22	1.46
3	---	---	0.17	---	---	---	---	---	---	---	0.1
4	---	---	0.17	---	---	0.50	---	---	0.06	---	0.97
5	---	---	0.17	0.22	---	0.61	0.30	0.09	0.06	---	1.44
6	---	---	0.75	0.22	---	0.11	0.30	0.09	---	---	.48
7	---	1.57	1.18	0.11	0.44	---	0.25	---	0.04	---	0.13

Table E-4: Truckloads On-Road, CSS-to-Maneuver Units (MEF Units)

CLASS IIIB & V, TRUCKLOADS BY TP								
TP	POL-B	M864	M549A1	M483A1	M107/CB	TOWII	JAVELIN	TOTAL
1	---	---	---	---	---	---	---	---
2	---	---	---	---	---	---	---	---
3	---	---	---	---	---	---	---	10.39
4	9.87	---	---	---	---	---	---	10.39
5	9.87	---	---	---	---	---	---	10.39
6	1.06	0.21	0.33	---	---	---	---	---
7	1.06	0.37	0.55	0.92	0.71	0.18	0.24	0.33

## APPENDIX F

### ACRONYM LIST

AAV	Amphibious Assault Vehicle
ADA	Air Defense Artillery
AFV	Armored Fighting Vehicle
AO	Area of Operation
AOE	Army of Excellence
AR	Army Regulation
AVIM	Aviation Intermediate Maintenance
AVUM	Aviation Unit Maintenance
ATACMS	Army Tactical Missile System
AVLB	Armored Vehicle Launch Bridge
BCMDVEH	Command Vehicle
BSA	Brigade Support Area
BSFV	Bradley Stinger Fighting Vehicle
BOH	Balance-on-Hand
C	Combat
CDS	Corps/Division Scenario
CEV	Combat Engineer Vehicle
CS	Combat Support
CSA	Corps Supply Area
CSS	Combat Service Support
DNBI	Disease and Non-battle Injury
DS	Direct Support
DSA	Division Support Area
EAC	Echelons Above Corps
FSB	Forward Support Battalion
Gals	Gallons
GS	General Support
HET	Heavy Equipment Transporter
HIMARS	High Mobility Artillery Rocket System
HMMWV	High Mobility Multi-purpose Wheeled Vehicle
IFV	Infantry Fighting Vehicle
LAV	Light Armored Vehicle
LO	Logistics
KIA	Killed in Action
MEF	Marine Expeditionary Force
MHBF	Mean Hours Between Failures

MHE	Materiel-Handling Equipment
MMH	Maintenance man-hour
MLRS	Multi-Launch Rocket System
MSR	Main Supply Route
ORG/DS	Organization/Direct Support
POL	Petroleum, Oil, Lubricant
RD	Return to Duty
RLT	Regimental Landing Team
RTC	Return to Combat
SPD	Supply Point Distribution
Stons	Short Tons
SWA	Southwest Asia
TOW	Tube Launched, Optically Sighted, Wire Guided
TP	Time Period
TRAC-FLVN SAC	TRADOC Analysis Center at Fort Leavenworth Study and Analysis Center
TRAC-LEE	TRADOC Analysis Center at Fort Lee
TRADOC	Training and Doctrine Command
UD	Unit Distribution
VIC	Vector-in-Commander